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CHARACTERIZING ORGANOHALOGEN FLAME RETARDANT (OFR) CHEMISTRIES, SOURCES, AND USES IN UNITED STATES AND INTERNATIONAL MARKETS

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A.1 OFR APPEARANCE ON U.S. AND INTERNATIONAL SUBSTANCE REGISTRIES

OFR CLASS	TOTAL NO. OF OFRS IN CLASS	COUNTRY/REGION, REGISTRY, AND YEAR(S), NUMBER OF SUBSTANCES APPEARING						NO. OF OFRS IN CLASS ON ANY REGISTRY	PERCENT OF OFRS IN CLASS ON ANY REGISTRY
		US TSCA INVENTORY 2021[A]	EU REACH 2021[B]	CANADA DSL 2021[C]	MEXICO INSQ 2009[D]	JAPAN CSCL 2021[E]	CHINA IECSC 2013[F]		
Polyhalogenated alicycles	22	4	2	5	2	15	5	17	77.3%
Polyhalogenated aliphatic carboxylate	3	2				3	1	3	100.0%
Polyhalogenated aliphatic chains	47	21	8	15	7	20	15	27	57.4%
Polyhalogenated benzene alicycles	4	1						0	0.0%
Polyhalogenated benzene aliphatics and functionalized	18	5	2		1	5	5	6	33.3%
Polyhalogenated benzenes	50	7	1	4	3	23	3	25	50.0%
Polyhalogenated bisphenol aliphatics and functionalized	14	6	5	3	1	9		9	64.3%
Polyhalogenated carbocycles	19	7	3	4	2	8	5	10	52.6%
Polyhalogenated organophosphates	42	11	6	11	3	26	12	29	70.7%
Polyhalogenated phenol derivatives	8	4	1	3	1	5	3	5	62.5%
Polyhalogenated phthalates/benzoates/imides	19	8	5	5		8	6	10	52.6%
Polyhalogenated triazines	6	1	2	1		2	2	2	33.3%
Polyhalogenated diphenyl ethers	223	11	1	9	2	44	8	47	21.1%
Polyhalogenated phenol-aliphatic ether	11	4	1	1	1	5	4	5	45.5%
Polyhalogenated carbocycles polyhalogenated benzene aliphatics and functionalized	2	0						0	0.0%
TOTAL	488	92	37	61	23	173	69	195	40.0%
Percent of all substances appearing on registry	--	18.9%	7.6%	12.5%	4.7%	35.5%	14.1%	40.0%	--

Sources and Notes:

[a] TSCA = Toxic Substances Control Act. These data are based on the public version of the TSCA Inventory, which includes only listings not claimed as Confidential Business Information (CBI). Thus, there may be additional, active OFR substances in commerce in the United States that cannot be identified because their listing in the TSCA Inventory is claimed as CBI. [As of February 2021, the non-CBI Inventory contained 68,167 substances, of which 33,607 (49.3 percent) were active. There were another 18,390 substances whose identity is claimed as confidential, of which 8,257 (44.9 percent) are active. In May, 2021, EPA announced that 390 substances on the CBI version of the Inventory would be moved to the non-CBI version following review of the CBI claims for these chemicals.]

[b] REACH = Registration, Evaluation, Authorisation, and Restriction of Chemicals. An inventory of substances manufactured in, or imported to, the EU on a commercial scale. Updated on a periodic basis to reflect new substances notifications.

[c] DSL = Canada Domestic Substances List. An inventory of substances manufactured in, or imported to, Canada on a commercial scale. Updated approximately 12 times per year to reflect new substances notifications.

[d] INSQ = Inventario Nacional de Sustancias Químicas (National Inventory of Chemical Substances). An inventory of substances manufactured in, or imported to, Mexico. Reporting is not mandatory and the preliminary list has not been updated since 2009.

[e] CSCL = Chemical Substances Control Law. An inventory of substances manufactured in, or imported to, Japan on a commercial scale. Updated regularly to reflect new substances notifications.

[f] IECSC = Inventory of Existing Chemical Substances Produced or Imported in China. Published in 2013 with no subsequent updates.

A.2 TSCA INVENTORY STATUS

OFR CLASS	ACTIVE	INACTIVE	NOT ON INVENTORY	TOTAL NO. OF CHEMICALS
Polyhalogenated alicycles	4	3	15	22
Polyhalogenated aliphatic carboxylate	2		1	3
Polyhalogenated aliphatic chains	21	3	23	47
Polyhalogenated benzene alicycles	1		3	4
Polyhalogenated benzene aliphatics and functionalized	5	3	10	18
Polyhalogenated benzenes	7	5	38	50
Polyhalogenated bisphenol aliphatics and functionalized	6	3	5	14
Polyhalogenated carbocycles	7	5	7	19
Polyhalogenated organophosphates	11	12	19	42
Polyhalogenated phenol derivatives	4	2	2	8
Polyhalogenated phthalates/benzoates/imides	8	3	8	19
Polyhalogenated triazines	1		5	6
Polyhalogenated diphenyl ethers	11		212	223
Polyhalogenated phenol-aliphatic ether	4	3	4	11
Polyhalogenated carbocycles polyhalogenated benzene aliphatics and functionalized			2	2
TOTAL	92	42	353	488
Source: TSCA Chemical Substance Inventory.				

A.3 NUMBER OF REPORTS BY ACTIVITY TYPE, 2015

OFR CLASS	TYPE OF ACTIVITY					
	DOMESTICALLY MANUFACTURED	DOMESTICALLY MANUFACTURED AND IMPORTED	IMPORTED	CBI	NOT SPECIFIED	TOTAL
Polyhalogenated alicycles	2		6	2		10
Polyhalogenated aliphatic chains	6		12	5	2	25
Polyhalogenated benzene aliphatics and functionalized	2		6	5	1	14
Polyhalogenated bisphenol aliphatics and functionalized	1	1	5	3	1	11
Polyhalogenated carbocycles	1		2			3
Polyhalogenated organophosphates	3		18	4	3	28
Polyhalogenated phenol derivatives	2		1			3
Polyhalogenated phthalates/benzoates/imides	9	1	4	3	2	19
Polyhalogenated diphenyl ethers			1	2	2	5
Polyhalogenated triazines				1		1
Polyhalogenated phenol-aliphatic ether			1			1
TOTAL	26	2	56	25	11	120
Source: U.S. EPA CDR (2016).						

A.4 NUMBER OF REPORTS BY CHEMICAL AND ACTIVITY TYPE, 2015

OFR CLASS AND CHEMICAL	DOMESTICALLY MANUFACTURED	DOMESTICALLY MANUFACTURED/ IMPORTED	IMPORTED	CBI	NOT SPECIFIED	TOTAL
POLYHALOGENATED ALICYCLES	2		6	2		10
25637-99-4	1		2	1		4
3194-55-6	1		3	1		5
77-47-4			1			1
POLYHALOGENATED ALIPHATIC CHAINS	6		12	5	2	25
1401974-24-0				1		1
1402738-52-6				1		1
1417900-96-9				1		1
3296-90-0			2	1		3
36483-57-5	1			1		2
61788-76-9			2			2
63449-39-8	2		8		2	12
68527-01-5	1					1
68527-02-6	2					2
POLYHALOGENATED BENZENE ALIPHATICS AND FUNCTIONALIZED	2		6	5	1	14
84852-53-9	2		6	5	1	14
POLYHALOGENATED BISPHENOL ALIPHATICS AND FUNCTIONALIZED	1	1	5	3	1	11
21850-44-2				1		1
25327-89-3			1			1
4162-45-2			1			1
79-94-7	1	1	3	2	1	8
POLYHALOGENATED CARBOCYCLES	1		2			3
115-27-5			1			1
13560-89-9	1		1			2
POLYHALOGENATED ORGANOPHOSPHATES	3		18	4	3	28
115-96-8			1			1
13674-84-5	1		13	1	2	17
13674-87-8	1		2	1	1	5
19186-97-1				1		1
38051-10-4				1		1
6294-34-4	1					1

OFR CLASS AND CHEMICAL	DOMESTICALLY MANUFACTURED	DOMESTICALLY MANUFACTURED/ IMPORTED	IMPORTED	CBI	NOT SPECIFIED	TOTAL
76025-08-6			2			2
POLYHALOGENATED PHENOL DERIVATIVES	2		1			3
118-79-6	2					2
42757-55-1			1			1
POLYHALOGENATED PHTHALATES/BENZOATES/IMIDES	9	1	4	3	2	19
117-08-8			1			1
183658-27-7	1					1
20566-35-2	3		1			4
26040-51-7	3					3
32588-76-4	1					1
632-79-1	1	1	2	3	2	9
POLYHALOGENATED DIPHENYL ETHERS			1	2	2	5
1163-19-5			1	2	2	5
POLYHALOGENATED TRIAZINES				1		1
25713-60-4				1		1
POLYHALOGENATED PHENOL-ALIPHATIC ETHER			1			1
3278-89-5			1			1
TOTAL	26	2	56	25	11	120

A.5 TOTAL POUNDS REPORTED BY CHEMICAL AND ACTIVITY, NONCONFIDENTIAL DATA ONLY, 2015 AND 2014, 2013, 2012

OFR CLASS AND CHEMICAL	NO. OF REPORTS[A]	DOMESTIC MANUFACTURE (LBS)	IMPORT (LBS)	DOMESTIC MANUFACTURE PLUS IMPORT (LBS)[B]	VOLUME USED ON SITE (LBS)	VOLUME EXPORTED (LBS)	TOTAL PRODUCTION VOLUME, (LBS), 2014	TOTAL PRODUCTION VOLUME (LBS), 2013	TOTAL PRODUCTION VOLUME (LBS), 2012
POLYHALOGENATED ALICYCLES	10	-	1,971,159	1,971,159	202,647	1,591,032	2,456,460	3,200,515	1,475,332
25637-99-4	4	-	177,480	177,480	-	-	-	-	-
3194-55-6	5	-	536,164	536,164	202,647	333,517	427,769	504,265	22,046
77-47-4	1	-	1,257,515	1,257,515	-	1,257,515	2,028,691	2,696,250	1,453,286
POLYHALOGENATED ALIPHATIC CHAINS	25	75,610,000	1,343,679	76,953,679	45,655	2,377,745	92,109,137	98,236,684	96,724,493
1401974-24-0	1	-	-	-	-	-	-	-	-
1402738-52-6	1	-	-	-	-	-	-	-	-
1417900-96-9	1	-		-	-	-	-	-	-
3296-90-0	3	-	602,831	602,831	-	54,233	427,637	196,209	52,910
36483-57-5	2	-	-	-	-	-	-	-	-
61788-76-9	2	-	10,355	10,355	10,355	-	8,891	6,246	9,292
63449-39-8	12	68,000,000	730,493	68,730,493	35,300	2,167,512	82,312,609	90,424,229	89,932,291
68527-01-5	1	210,000	-	210,000	-	-	360,000	410,000	330,000
68527-02-6	2	7,400,000	-	7,400,000	-	156,000	9,000,000	7,200,000	6,400,000
POLYHALOGENATED BENZENE ALIPHATICS AND FUNCTIONALIZED	14	-	536,123	536,123	-	250,000	658,246	535,516	622,069
84852-53-9	14	-	536,123	536,123		250,000	658,246	535,516	622,069
POLYHALOGENATED BISPHENOL ALIPHATICS AND FUNCTIONALIZED	11	-	78,704	78,704	-	-	69,555	26,646	80,248
21850-44-2	1	-	-	-	-	-	-	-	-
25327-89-3	1	-	-	-	-	-	-	-	-
4162-45-2	1	-	12,566	12,566	-	-	25,463	4,630	58,202
79-94-7	8	-	66,138	66,138	-	-	44,092	22,016	22,046
POLYHALOGENATED CARBOCYCLES	3	-	802,482	802,482	-	802,482	1,238,759	1,265,139	1,389,706
115-27-5	1	-	802,482	802,482	-	802,482	1,040,581	1,073,650	1,389,706
13560-89-9	2		-	-	-	-	198,178	191,489	-
POLYHALOGENATED ORGANOPHOSPHATES	28	50,088,182	5,349,340	64,266,362	3,535,185	3,616,235	65,058,589	59,892,351	58,227,373
115-96-8	1	-	39,682	39,682	-	-	158,728	39,682	79,364
13674-84-5	17	38,488,041	11,345,820	48,662,701	189,610	3,591,976	48,794,511	45,353,434	37,579,445

OFR CLASS AND CHEMICAL	NO. OF REPORTS[A]	DOMESTIC MANUFACTURE (LBS)	IMPORT (LBS)	DOMESTIC MANUFACTURE PLUS IMPORT (LBS)[B]	VOLUME USED ON SITE (LBS)	VOLUME EXPORTED (LBS)	TOTAL PRODUCTION VOLUME, (LBS), 2014	TOTAL PRODUCTION VOLUME (LBS), 2013	TOTAL PRODUCTION VOLUME (LBS), 2012
13674-87-8	5	11,600,141	3,087,177	14,687,318	3,345,575	22,080	15,306,692	13,508,589	19,809,021
19186-97-1	1	-	-	-	-	-	-	-	-
38051-10-4	1	-	-	-	-	-	-	-	-
6294-34-4	1	-	-	-	-	2,179	-	-	-
76025-08-6	2	-	876,661	876,661	-	-	798,658	990,646	759,543
POLYHALOGENATED PHENOL DERIVATIVES	3	-	27,557	27,557	-	-	-	276	-
118-79-6	2	-	-	-	-	-	-	-	-
42757-55-1	1	-	27,557	27,557	-	-	-	276	-
POLYHALOGENATED PHTHALATES/BENZOATES/IMIDES	19	8,270,502	1,376,832	9,647,334	-	1,050,247	8,982,680	8,121,647	7,943,212
117-08-8	1	-	110,000	110,000	-	-	-	10,000	-
183658-27-7	1	-	-	-	-	-	-	-	-
20566-35-2	4	1,174,900	-	1,174,900	-	-	223,797	176,156	196,356
26040-51-7	3	7,095,602	-	7,095,602	-	1,050,247	7,085,682	6,816,785	6,612,673
32588-76-4	1	-	-	-	-	-	-	-	-
632-79-1	9	-	1,266,832	1,266,832	-	-	1,673,201	1,118,706	1,134,183
POLYHALOGENATED DIPHENYL ETHERS	5	-	573,192	573,192	529,100	-	284,330	275,413	64,167
1163-19-5	5	-	573,192	573,192	529,100	-	284,330	275,413	64,167
POLYHALOGENATED TRIAZINES	1	-	-	-	-	-	-	-	-
25713-60-4	1	-	-	-	-	-	-	-	-
POLYHALOGENATED PHENOL-ALIPHATIC ETHER	1	-	-	-	-	-	-	-	-
3278-89-5	1	-	-	-	-	-	-	-	-
TOTAL	120	133,968,684	22,059,068	154,856,592	4,312,587	9,687,741	170,857,756	171,554,187	166,526,600

Source: U.S. EPA CDR (2016).

[a] The pounds reported in this table only include those amounts not claimed as CBI. Where the number of reports for a chemical is greater than zero and no pounds are reported, this means all amounts in those reports are CBI.

[b] This total does not equal the sum of domestic manufacture plus imports shown in the table. One submitter reported 0 pounds manufactured and 1.39 million pounds imported, but a combined production plus import total of 2.2 million pounds. This entry accounts for the discrepancy.

A.6 NUMBER OF REPORTS, CONSUMER USE REPORTS, AND CHILD USE REPORTS, 2015

OFR CLASS	NO. OF CHEMICALS IN CLASS	NO. OF REPORTS	NO. OF CONSUMER USE REPORTS	NO. OF CONSUMER USE (CBI) REPORTS	NO. OF CHILD USE REPORTS	NO. OF CHILD USE (CBI) REPORTS
Polyhalogenated alicycles	22	10	2	0	0	0
Polyhalogenated aliphatic carboxylate	3	0				
Polyhalogenated aliphatic chains	47	25	2	4	0	0
Polyhalogenated benzene alicycles	4	0				
Polyhalogenated benzene aliphatics and functionalized	18	14	9	1	1	0
Polyhalogenated benzenes	50	0				
Polyhalogenated bisphenol aliphatics and functionalized	14	11	4	0	2	0
Polyhalogenated carbocycles	19	3	3	0	0	0
Polyhalogenated organophosphates	42	28	8	0	0	0
Polyhalogenated phenol derivatives	8	3	0	0	0	0
Polyhalogenated phthalates/benzoates/imides	19	19	6	0	3	0
Polyhalogenated triazines	6	1	0	0	0	0
Polyhalogenated diphenyl ethers	223	5	0	0	0	0
Polyhalogenated phenol-aliphatic ether	11	1				
Polyhalogenated carbocycles polyhalogenated benzene aliphatics and functionalized	2	0				
TOTAL	488	120	34	5	6	0
Source: U.S. EPA CDR (2016).						

A.7 NUMBER OF REPORTS, CONSUMER USE REPORTS, AND CHILD USE REPORTS, BY CHEMICAL, 2015

OFR CLASS, CAS NO., AND CHEMICAL NAME	NO. OF REPORTS	NO. OF CONSUMER USE REPORTS	NO. OF CONSUMER USE (CBI) REPORTS	NO. OF CHILD USE REPORTS	NO. OF CHILD USE (CBI) REPORTS
POLYHALOGENATED ALICYCLES	10	2	0	0	0
25637-99-4 (Hexabromocyclododecane)	4	1	0	0	0
3194-55-6 (1,2,5,6,9,10-Hexabromocyclododecane)	5	1	0	0	0
77-47-4 (Hexachlorocyclopentadiene)	1	0	0	0	0
POLYHALOGENATED ALIPHATIC CHAINS	25	2	4	0	0
1401974-24-0 (Alkanes, C22-30-branched and linear, chloro)	1	0	2	0	0
1402738-52-6 (Alkanes, C24-28, chloro)	1	0	2	0	0
1417900-96-9 (Alkanes, C21-34-branched and linear, chloro)	1	0	0	0	0
3296-90-0 (Pentaerythritol dibromide)	3	0	0	0	0
36483-57-5 (Tribromoneopentyl alcohol)	2	1	0	0	0
61788-76-9 (Chloroalkanes)	2	0	0	0	0
63449-39-8 (Chlorinated paraffins)	12	1	0	0	0
68527-01-5 (Bromo chloro C12-30 a-alkenes)	1				
68527-02-6 (Alkenes, C12-24, chloro)	2				
POLYHALOGENATED BENZENE ALIPHATICS AND FUNCTIONALIZED	14	9	1	1	0
84852-53-9 (1,1'-Ethane-1,2-diylbis(pentabromobenzene))	14	9	1	1	0
POLYHALOGENATED BISPHENOL ALIPHATICS AND FUNCTIONALIZED	11	4	0	2	0
21850-44-2 (Tetrabromobisphenol A-bis(2,3-dibromopropyl ether))	1	0	0	0	0
25327-89-3 (Tetrabromobisphenol A diallyl ether)	1				
4162-45-2 (Tetrabromobisphenol A bis(2-hydroxyethyl) ether)	1	0	0	0	0
79-94-7 (3,3',5,5'-Tetrabromobisphenol A)	8	4	0	2	0
POLYHALOGENATED CARBOCYCLES	3	3	0	0	0
115-27-5 (Chlorendic anhydride)	1	0	0	0	0
13560-89-9 (Dechlorane Plus)	2	3	0	0	0
POLYHALOGENATED DIPHENYL ETHERS	5	0	0	0	0
1163-19-5 (1,1'-Oxybis[2,3,4,5,6-pentabromobenzene])	5	0	0	0	0
POLYHALOGENATED ORGANOPHOSPHATES	28	8	0	0	0
115-96-8 (Tris(2-chloroethyl) phosphate)	1				
13674-84-5 (Tris(2-chloroisopropyl)phosphate)	17	6	0	0	0

OFR CLASS, CAS NO., AND CHEMICAL NAME	NO. OF REPORTS	NO. OF CONSUMER USE REPORTS	NO. OF CONSUMER USE (CBI) REPORTS	NO. OF CHILD USE REPORTS	NO. OF CHILD USE (CBI) REPORTS
13674-87-8 (Tris(1,3-dichloro-2-propyl) phosphate)	5	2	0	0	0
19186-97-1 (Tris(tribromoneopentyl)phosphate)	1	0	0	0	0
38051-10-4 (Phosphoric acid, 2,2-bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester)	1	0	0	0	0
6294-34-4 (Bis(2-chloroethyl) 2-chloroethylphosphonate)	1				
76025-08-6 (Bis(2-chloro-1-methylethyl) 2-chloropropyl phosphate)	2	0	0	0	0
POLYHALOGENATED PHENOL DERIVATIVES	3	0	0	0	0
118-79-6 (2,4,6-Tribromophenol)	2				
42757-55-1 (1,1'-Sulfonylbis[3,5-dibromo-4-(2,3-dibromopropoxy)benzene])	1	0	0	0	0
POLYHALOGENATED PHENOL-ALIPHATIC ETHER	1				
3278-89-5 (1,3,5-Tribromo-2-(prop-2-en-1-yloxy)benzene)	1				
POLYHALOGENATED PHTHALATES/BENZOATES/IMIDES	19	6	0	3	0
117-08-8 (Tetrachlorophthalic anhydride)	1				
183658-27-7 (2-Ethylhexyl 2,3,4,5-tetrabromobenzoate)	1	1	0	1	0
20566-35-2 (2-(2-Hydroxyethoxy)ethyl 2-hydroxypropyl 3,4,5,6-tetrabromophthalate)	4	0	0	0	0
26040-51-7 (Bis(2-ethylhexyl) tetrabromophthalate)	3	5	0	2	0
32588-76-4 (1,2-Bis(tetrabromophthalimido)ethane)	1	0	0	0	0
632-79-1 (4,5,6,7-Tetrabromo-1,3-Isobenzofurandione)	9	0	0	0	0
POLYHALOGENATED TRIAZINES	1	0	0	0	0
25713-60-4 (2,4,6-Tris-(2,4,6-tribromophenoxy)-1,3,5-triazine)	1	0	0	0	0
TOTAL	120	34	5	6	0
Source: U.S. EPA CDR (2016).					

A.8 NUMBER OF REPORTS BY TYPE OF INDUSTRIAL PROCESSING OR USE, 2015

OFR CLASS	TYPE OF INDUSTRIAL PROCESSING OR USE - NO. OF REPORTS BY TYPE							
	PROCESSING AS A REACTANT	PROCESSING—INCORPORATION INTO ARTICLE	PROCESSING—INCORPORATION INTO FORMULATION, MIXTURE, OR REACTION PRODUCT	PROCESSING—REPACKAGING	USE—NON-INCORPORATIVE ACTIVITIES	NOT KNOWN OR REASONABLY ASCERTAINABLE	CBI	TOTAL
Polyhalogenated diphenyl ethers		1	2					3
Polyhalogenated alicycles	2	7	6					15
Polyhalogenated aliphatic chains	1	1	42	1		1	8	54
Polyhalogenated benzene aliphatics and functionalized		4	7		2		3	16
Polyhalogenated bisphenol aliphatics and functionalized	3	5	10					18
Polyhalogenated carbocycles			6	1		1		8
Polyhalogenated organophosphates	4		22			1	1	28
Polyhalogenated phenol derivatives	2	1						3
Polyhalogenated phenol-aliphatic ethers	1							1
Polyhalogenated phthalates/benzoates/imides	6	4	14	1				25
Polyhalogenated triazines			1					1
TOTAL	19	23	110	3	2	3	12	172
Source: U.S. EPA CDR (2016).								

A.9 NUMBER OF REPORTS BY INDUSTRIAL USE SECTOR, 2015

OFR Class	INDUSTRIAL USE SECTOR - NUMBER OF REPORTS BY SECTOR																						
	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint And Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	Not Known or Reasonably Ascertainable	CBI	Total
Polyhalogenated diphenyl ethers																	1			2				3
Polyhalogenated alicycles		1				9								1		3	1							15
Polyhalogenated aliphatic chains	4		1	4					1	1			8		6	3	7	5	1	4		1	8	54
Polyhalogenated benzene aliphatics and functionalized							1									4	6			1			4	16
Polyhalogenated bisphenol aliphatics and functionalized				2	1			4			1					4	4			1	1			18
Polyhalogenated carbocycles											1		1			1						1	4	8
Polyhalogenated organophosphates			1	1		9				3		1		1		4	3			2		1	2	28
Polyhalogenated phenol derivatives		1		1				1																3
Polyhalogenated phenol-aliphatic ethers				1																				1
Polyhalogenated phthalates/benzoates/imides	1		5	2		1	1			4			1			3	7							25
Polyhalogenated triazines																	1							1
TOTAL	5	2	7	11	1	19	2	5	1	8	2	1	10	2	6	22	30	5	1	10	1	3	18	172
Source: U.S. EPA CDR (2016).																								

A.10 NUMBER OF REPORTS BY INDUSTRIAL FUNCTION CATEGORY, 2015

OFR Class	NUMBER OF REPORTS BY FUNCTION														
	Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Other	Paint Additives and Coating Additives Not Described by Other	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	Not Known or Reasonably Ascertainable	CBI	Total
Polyhalogenated diphenyl ethers				3											3
Polyhalogenated alicycles				12		2		1							15
Polyhalogenated aliphatic chains				33		1	7		2	1		1	1	8	54
Polyhalogenated benzene aliphatics and functionalized		1		11										4	16
Polyhalogenated bisphenol aliphatics and functionalized				13	1	3					1				18
Polyhalogenated carbocycles				6		1							1		8
Polyhalogenated organophosphates	2		1	19		1			2				1	2	28
Polyhalogenated phenol derivatives				1		2									3
Polyhalogenated phenol-aliphatic ethers						1									1
Polyhalogenated phthalates/benzoates/ imides	1			16		4				3	1				25
Polyhalogenated triazines				1											1
TOTAL	3	1	1	115	1	15	7	1	4	4	2	1	3	14	172

Source: U.S. EPA CDR (2016).

Note: For a full list of functional uses, including uses not claimed for these OFRs, see https://www.epa.gov/sites/default/files/2016-05/documents/instructions_for_reporting_2016_tsca_cdr_13may2016.pdf (Appendix D).

A.11 NUMBER OF REPORTS BY CHEMICAL AND INDUSTRIAL FUNCTION CATEGORY, 2015

CAS No.	Chemical Name	NUMBER OF REPORTS BY FUNCTION														
		Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Not Known or Reasonably Ascertainable	Paint Additives and Coating Additives Not Described by Other Categories	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	Other	CBI	Total
63449-39-8	Chlorinated paraffins				16			4	1	2	1					24
115-27-5	Chlorendic anhydride				2											2
115-96-8	Tris(2-chloroethyl) phosphate								1							1
1163-19-5	1,1'-Oxybis[2,3,4,5,6-pentabromobenzene]				3											3
117-08-8	Tetrachlorophthalic anhydride										1					1
118-79-6	2,4,6-Tribromophenol						2									2
13560-89-9	Dechlorane Plus				4		1		1							6
13674-84-5	Tris(2-chloroisopropyl) phosphate	2		1	12					2						17
13674-87-8	Tris(1,3-dichloro-2-propyl) phosphate				3											3
1401974-24-0	Alkanes, C22-30-branched and linear, chloro														2	2
1402738-52-6	Alkanes, C24-28, chloro														2	2
1417900-96-9	Alkanes, C21-34-branched and linear, chloro														4	4
183658-27-7	2-Ethylhexyl 2,3,4,5-tetrabromobenzoate				2											2
19186-97-1	Tris(tribromoneopentyl) phosphate				1											1
20566-35-2	2-(2-Hydroxyethoxy)ethyl 2-hydroxypropyl 3,4,5,6-tetrabromophthalate				2		1					1				4
21850-44-2	Tetrabromobisphenol A-bis(2,3-dibromopropyl ether)				1											1

CAS No.	Chemical Name	NUMBER OF REPORTS BY FUNCTION														
		Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Not Known or Reasonably Ascertainable	Paint Additives and Coating Additives Not Described by Other Categories	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	Other	CBI	Total
25327-89-3	Tetrabromobisphenol A diallyl ether				2											2
25637-99-4	Hexabromocyclododecane				6									1		7
25713-60-4	2,4,6-Tris-(2,4,6-tribromophenoxy)-1,3,5-triazine				1											1
26040-51-7	Bis(2-ethylhexyl) tetrabromophthalate				6						2					8
3194-55-6	1,2,5,6,9,10-Hexabromocyclododecane				5		1									6
32588-76-4	1,2-Bis(tetrabromophthalimido) ethane				3											3
3278-89-5	1,3,5-Tribromo-2-(prop-2-en-1-yloxy)benzene						1									1
3296-90-0	Pentaerythritol dibromide				2								1			3
36483-57-5	Tribromoneopentyl alcohol				2											2
38051-10-4	Phosphoric acid, 2,2-bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester														2	2
4162-45-2	Tetrabromobisphenol A bis(2-hydroxyethyl) ether				1											1
42757-55-1	1,1'-Sulfonylbis[3,5-dibromo-4-(2,3-dibromopropoxy)benzene]				1											1
61788-76-9	Chloroalkanes						1	1								2
6294-34-4	Bis(2-chloroethyl) 2-chloroethylphosphonate						1									1
632-79-1	4,5,6,7-Tetrabromo-1,3-Isobenzofurandione	1			3		3									7

CAS No.	Chemical Name	NUMBER OF REPORTS BY FUNCTION														
		Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Not Known or Reasonably Ascertainable	Paint Additives and Coating Additives Not Described by Other Categories	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	Other	CBI	Total
68527-01-5	Bromo chloro C12-30 a-alkenes				1											1
68527-02-6	Alkenes, C12-24, chloro				12			2								14
76025-08-6	Bis(2-chloro-1-methylethyl) 2-chloropropyl phosphate				3											3
77-47-4	Hexachlorocyclopentadiene				1		1									2
79-94-7	3,3',5,5'-Tetrabromobisphenol A				9	1	3					1				14
84852-53-9	1,1'-Ethane-1,2-diylbis(pentabromobenzene)		1		11										4	16
TOTAL		3	1	1	115	1	15	7	3	4	4	2	1	1	14	172

Source: U.S. EPA CDR (2016).

Notes: Green-shaded rows identify chemicals without reported use as flame retardants (excluding chemicals with functional uses claimed as CBI).
Red-shaded rows identify chemicals with reported use as flame retardants and at least one other functional use.
Unshaded rows identify chemicals with reported use as a flame retardant and no other functional use (or only uses claimed as CBI).
For a full list of functional uses, including uses not claimed for these OFRs, see https://www.epa.gov/sites/default/files/2016-05/documents/instructions_for_reporting_2016_tsca_cdr_13may2016.pdf (Appendix D).

A.12 NUMBER OF REPORTS BY NUMBER OF SITES PROCESSING OR USING, 2015

OFR CLASS	NUMBER OF SITES PROCESSING OR USING – NUMBER OF REPORTS							
	FEWER THAN 10 SITES	AT LEAST 10 BUT FEWER THAN 25 SITES	AT LEAST 25 BUT FEWER THAN 100 SITES	AT LEAST 100 BUT FEWER THAN 250 SITES	AT LEAST 10,000 SITES	NOT KNOWN OR REASONABLY ASCERTAINABLE	CBI	TOTAL
Polyhalogenated diphenyl ethers	1	1	1					3
Polyhalogenated alicycles	10	1	2			2		15
Polyhalogenated aliphatic chains	20	13	6			6	9	54
Polyhalogenated benzene aliphatics and functionalized	8	3	2	1		1	1	16
Polyhalogenated bisphenol aliphatics and functionalized	6	9	1			2		18
Polyhalogenated carbocycles	5	2				1		8
Polyhalogenated organophosphates	16	5	5		1	1		28
Polyhalogenated phenol derivatives	3							3
Polyhalogenated phenol-aliphatic ethers	1							1
Polyhalogenated phthalates/benzoates/imides	20	2	3					25
Polyhalogenated triazines		1						1
TOTAL	90	37	20	1	1	13	10	172
Source: U.S. EPA CDR (2016).								

A.13 CONSUMER AND COMMERCIAL USES - NUMBER OF REPORTS BY PRODUCT CATEGORY, 2015

OFR Class and Consumer/ Commercial Use Category	PRODUCT CATEGORY																
	Adhesives and Sealants	Batteries	Building/Construction Materials - Wood and Engineered Wood Products	Building/Construction Materials Not Covered Elsewhere	Electrical and Electronic Products	Fabric, Textile, and Leather Products Not Covered Elsewhere	Other (Flame Retardant)	Foam Seating and Bedding Products	Industrial Manufacturing	Insulating Foam	Intermediate for Agricultural (Pesticides and Fungicides)	Lubricants and Greases	Paints and Coatings	Plastic and Rubber Products Not Covered Elsewhere	Not Known or Reasonably Ascertainable	CBI	Total
Polyhalogenated diphenyl ethers						2								1			3
Commercial						2								1			3
Polyhalogenated alicycles				6	1						1			1			9
Consumer				1													1
Commercial				4	1						1			1			7
Consumer and commercial				1													1
Polyhalogenated aliphatic chains								1				3	4	3	1	9	21
Commercial												3	4	2			9
Consumer and commercial								1						1			2
NKRA															1	5	6
CBI																4	4
Polyhalogenated benzene aliphatics and functionalized				1	5	2								2	1	3	14
Commercial					1	1								1			3
Consumer and commercial				1	4	1								1		2	9
NKRA															1		1
CBI																1	1
Polyhalogenated bisphenol aliphatics and functionalized				1	4				1					2			8
Commercial				1					1					2			4
Consumer and commercial					4												4
Polyhalogenated carbocycles				1	1								1	2			5
Consumer and commercial				1	1									1			3
NKRA													1	1			2

OFR Class and Consumer/ Commercial Use Category	PRODUCT CATEGORY																
	Adhesives and Sealants	Batteries	Building/Construction Materials - Wood and Engineered Wood Products	Building/Construction Materials Not Covered Elsewhere	Electrical and Electronic Products	Fabric, Textile, and Leather Products Not Covered Elsewhere	Other (Flame Retardant)	Foam Seating and Bedding Products	Industrial Manufacturing	Insulating Foam	Intermediate for Agricultural (Pesticides and Fungicides)	Lubricants and Greases	Paints and Coatings	Plastic and Rubber Products Not Covered Elsewhere	Not Known or Reasonably Ascertainable	CBI	Total
Polyhalogenated organophosphates	2		1	11	1	1	1	4		1				2		5	29
Consumer				1													1
Commercial	1		1	9		1	1	2						2		4	21
Consumer and commercial	1			1	1			2		1						1	7
Polyhalogenated phenol derivatives		1															1
Commercial		1															1
Polyhalogenated phthalates/benzoates/imides	1			5	4	1		2					2	2			17
Commercial	1			5	2								2	1			11
Consumer and commercial					2	1		2						1			6
Polyhalogenated triazines														1			1
Commercial														1			1
TOTAL	3	1	1	25	16	6	1	7	1	1	1	3	7	16	2	17	108

Source: U.S. EPA CDR (2016).
Notes:
For purposes of CDR reporting, a commercial use means the use of a chemical substance or a mixture (including as part of an article) in a commercial enterprise providing saleable goods or a service (40 CFR 711.3). A consumer use, on the other hand, means the use of a chemical substance or a mixture (including as part of an article) when sold to or made available to consumers for their use (40 CFR 711.3).
"Flame Retardant" is not included as a separate product category under CDR reporting guidance. Chemicals that do not fall into one of the listed categories must be reported as "Other." When selecting "other," reporters must provide a description of the product. For more information, see https://www.epa.gov/sites/default/files/2016-05/documents/instructions_for_reporting_2016_tsca_cdr_13may2016.pdf (Section 4.8.2.1).
NKRA = Not known or reasonably ascertainable. This indicates the reporter did not know the or could not ascertain a product category for the reported use.

A.14 COMMERCIAL/CONSUMER USE (REPORTING OPTIONAL) – NUMBER OF REPORTS BY USE, 2015

OFR CLASS	COMMERCIAL/CONSUMER USE (OPTIONAL)					
	COMMERCIAL	CONSUMER	BOTH	NKRA	CBI	TOTAL
Polyhalogenated alicycles	3					3
Polyhalogenated aliphatic chains	7	1	1			9
Polyhalogenated benzene aliphatics and functionalized	9		2	6	4	21
Polyhalogenated bisphenol aliphatics and functionalized	3		9	1	1	14
Polyhalogenated carbocycles	4		4			8
Polyhalogenated organophosphates			3	2		5
Polyhalogenated phenol derivatives	21	1	7			29
Polyhalogenated phthalates/benzoates/imides	1					1
Polyhalogenated diphenyl ethers	11		6			17
Polyhalogenated triazines	1					1
TOTAL	60	2	32	9	5	108

Source: U.S. EPA CDR (2016).
Notes:
Use Identification. For each Product Category reported, reporters have the option to indicate whether the use is a consumer use, commercial use, or consumer and commercial use ("both").
NKRA = Not known or reasonably ascertainable. This indicates the reporter did not know or could not ascertain the reported use.

A.15 COMMERCIAL/CONSUMER USE (OPTIONAL) – NUMBER OF REPORTS BY CHEMICAL AND USE, 2015

OFR CLASS AND CHEMICAL	COMMERCIAL/CONSUMER USE (OPTION)					
	COMMERCIAL	CONSUMER	BOTH	NKRA	CBI	TOTAL
POLYHALOGENATED ALICYCLES	7	1	1			9
25637-99-4 (Cyclododecane, hexabromo-)	4		1			5
3194-55-6 (Cyclododecane, 1,2,5,6,9,10-hexabromo-)	1	1				2
77-47-4 (1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-)	2					2
POLYHALOGENATED ALIPHATIC CHAINS	9		2	6	4	21
1401974-24-0 (Alkanes, C22-30-branched and linear, chloro)					2	2
1402738-52-6 (Alkanes, C24-28, chloro)					2	2
1417900-96-9 (Alkanes, C21-34-branched and linear, chloro)				5		5
3296-90-0 (1,3-Propanediol, 2,2-bis(bromomethyl)-)	3					3
36483-57-5 (1-Propanol, 2,2-dimethyl-, tribromo deriv.)	1		1			2
61788-76-9 (Alkanes, chloro)	1					1
63449-39-8 (Paraffin waxes and Hydrocarbon waxes, chloro)	4		1	1		6
POLYHALOGENATED BENZENE ALIPHATICS AND FUNCTIONALIZED	3		9	1	1	14
84852-53-9 (Benzene, 1,1'-(1,2-ethanediyl)bis[2,3,4,5,6-pentabromo-)	3		9	1	1	14
POLYHALOGENATED BISPHENOL ALIPHATICS AND FUNCTIONALIZED	4		4			8
21850-44-2 (Benzene, 1,1'-(1-methylethylidene)bis[3,5-dibromo-4-(2,3-dibromopropoxy)-)	1					1
4162-45-2 (Ethanol, 2,2'-[(1-methylethylidene)bis[(2,6-dibromo-4,1-phenylene)oxy]]bis-)	1					1
79-94-7 (Phenol, 4,4'-(1-methylethylidene)bis[2,6-dibromo-)	2		4			6
POLYHALOGENATED CARBOCYCLES			3	2		5
115-27-5 (4,7-Methanoisobenzofuran-1,3-dione, 4,5,6,7,8,8-hexachloro-3a,4,7,7a-tetrahydro-)				2		2
13560-89-9 (1,4:7,10-Dimethanodibenzo[a,e]cyclooctene, 1,2,3,4,7,8,9,10,13,13,14,14-dodecachloro-1 ,4,4a,5,6,6a,7,10,10a,11,12,12a-dodecahydro-)			3			3
POLYHALOGENATED ORGANOPHOSPHATES	21	1	7			29
13674-84-5 (2-Propanol, 1-chloro-, 2,2',2"-phosphate)	13	1	5			19
13674-87-8 (2-Propanol, 1,3-dichloro-, 2,2',2"-phosphate)			2			2
19186-97-1 (1-Propanol, 3-bromo-2,2-bis(bromomethyl)-, 1,1',1"-phosphate)	1					1
38051-10-4 (Phosphoric acid, P,P'-[2,2-bis(chloromethyl)-1,3-propanediyl] P,P,P',P'-tetrakis(2-chloroethyl) ester)	4					4
76025-08-6 (Phosphoric acid, bis(2-chloro-1-methylethyl) 2-chloropropyl ester)	3					3

OFR CLASS AND CHEMICAL	COMMERCIAL/CONSUMER USE (OPTION)					
	COMMERCIAL	CONSUMER	BOTH	NKRA	CBI	TOTAL
POLYHALOGENATED PHENOL DERIVATIVES	1					1
42757-55-1 (Benzene, 1,1'-sulfonylbis[3,5-dibromo-4-(2,3-dibromopropoxy)-)	1					1
POLYHALOGENATED PHTHALATES/BENZOATES/IMIDES	11		6			17
183658-27-7 (Benzoic acid, 2,3,4,5-tetrabromo-, 2-ethylhexyl ester)			1			1
20566-35-2 (1,2-Benzenedicarboxylic acid, 3,4,5,6-tetrabromo-, 1-[2-(2-hydroxyethoxy)ethyl] 2-(2-hydroxypropyl) ester)	3					3
26040-51-7 (1,2-Benzenedicarboxylic acid, 3,4,5,6-tetrabromo-, 1,2-bis(2-ethylhexyl) ester)	1		5			6
32588-76-4 (1H-Isoindole-1,3(2H)-dione, 2,2'-(1,2-ethanediyl)bis[4,5,6,7-tetrabromo-)	3					3
632-79-1 (1,3-Isobenzofurandione, 4,5,6,7-tetrabromo-)	4					4
POLYHALOGENATED DIPHENYL ETHERS	3					3
1163-19-5 (Benzene, 1,1'-oxybis[2,3,4,5,6-pentabromo-)	3					3
POLYHALOGENATED TRIAZINES	1					1
25713-60-4 (1,3,5-Triazine, 2,4,6-tris(2,4,6-tribromophenoxy)-)	1					1
TOTAL	60	2	32	9	5	108
Source: U.S. EPA CDR (2016).						

A.16 USE IN PRODUCTS INTENDED FOR CHILDREN – NUMBER OF REPORTS, 2015

OFR CLASS	USE IN PRODUCTS INTENDED FOR CHILDREN			
	YES	NO	NKRA	TOTAL
Polyhalogenated alicycles		9		9
Polyhalogenated aliphatic chains		12	9	21
Polyhalogenated benzene aliphatics and functionalized	1	11	2	14
Polyhalogenated bisphenol aliphatics and functionalized	2	5	1	8
Polyhalogenated carbocycles		5		5
Polyhalogenated organophosphates		21	8	29
Polyhalogenated phenol derivatives		1		1
Polyhalogenated phthalates/benzoates/imides	3	13	1	17
Polyhalogenated diphenyl ethers		3		3
Polyhalogenated triazines		1		1
TOTAL	6	81	21	108

Source: U.S. EPA CDR (2016).

Notes:

Determining intended uses. Within each consumer product category reported, reporters must determine whether any amount of each reportable chemical substance manufactured (including imported) is present in or on any consumer product(s) intended for use by children age 14 or younger. EPA defines "intended for use by children" to mean the chemical substance or mixture is used in or on a product that is specifically intended for use by children age 14 or younger (40 CFR 711.3). A chemical substance or mixture is intended for use by children the answer to at least one of the following questions about the product into which your chemical substance or mixture is incorporated is "Yes":

- Is the product commonly recognized (i.e., by a reasonable person) as being intended for use by children age 14 or younger?
- Does the manufacturer of the product state through product labeling or other written materials that the product is intended or will be used by children age 14 or younger?
- Is the advertising, promotion, or marketing of the product aimed at children age 14 or younger?

NKRA = Not known or reasonably ascertainable. This indicates the reporter did not know or could not ascertain the intended use.

A.17 USE IN PRODUCTS INTENDED FOR CHILDREN – NUMBER OF REPORTS BY CHEMICAL, 2015

OFR CLASS, CHEMICAL, AND PRODUCT USE	USE IN PRODUCTS INTENDED FOR CHILDREN			
	YES	NO	NKRA	TOTAL
POLYHALOGENATED ALICYCLES		9		9
25637-99-4 (Cyclododecane, hexabromo-)		5		5
Building/construction materials not covered elsewhere		4		4
Electrical and electronic products		1		1
3194-55-6 (Cyclododecane, 1,2,5,6,9,10-hexabromo-)		2		2
Building/construction materials not covered elsewhere		2		2
77-47-4 (1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-)		2		2
Intermediate for agricultural (pesticides and fungicides)		1		1
Plastic and rubber products not covered elsewhere		1		1
POLYHALOGENATED ALIPHATIC CHAINS		12	9	21
1401974-24-0 (Alkanes, C22-30-branched and linear, chloro)			2	2
CBI			2	2
1402738-52-6 (Alkanes, C24-28, chloro)		1	1	2
CBI		1	1	2
1417900-96-9 (Alkanes, C21-34-branched and linear, chloro)		1	4	5
CBI		1	4	5
3296-90-0 (1,3-Propanediol, 2,2-bis(bromomethyl)-)		3		3
Plastic and rubber products not covered elsewhere		1		1
Paints and coatings		2		2
36483-57-5 (1-Propanol, 2,2-dimethyl-, tribromo deriv.)		1	1	2
Foam seating and bedding products			1	1
Plastic and rubber products not covered elsewhere		1		1
61788-76-9 (Alkanes, chloro)		1		1
Lubricants and greases		1		1
63449-39-8 (Paraffin waxes and Hydrocarbon waxes, chloro)		5	1	6
Lubricants and greases		2		2
Plastic and rubber products not covered elsewhere		1		1
Paints and coatings		2		2
NKRA			1	1
POLYHALOGENATED BENZENE ALIPHATICS AND FUNCTIONALIZED	1	11	2	14
84852-53-9 (Benzene, 1,1'-(1,2-ethanediyl)bis[2,3,4,5,6-pentabromo-)	1	11	2	14
Building/construction materials not covered elsewhere		1		1
Electrical and electronic products	1	4		5
Fabric, textile, and leather products not covered elsewhere		2		2
Plastic and rubber products not covered elsewhere		2		2
CBI		2	1	3
NKRA			1	1
POLYHALOGENATED BISPHENOL ALIPHATICS AND FUNCTIONALIZED	2	5	1	8
21850-44-2 (Benzene, 1,1'-(1-methylethylidene)bis[3,5-d ibromo-4-(2,3-dibromopropoxy)-)		1		1
Plastic and rubber products not covered elsewhere		1		1
4162-45-2 (Ethanol, 2,2'-[(1-methylethylidene)bis[(2,6-d ibromo-4,1-phenylene)oxy]]bis-)			1	1
Plastic and rubber products not covered elsewhere			1	1

OFR CLASS, CHEMICAL, AND PRODUCT USE	USE IN PRODUCTS INTENDED FOR CHILDREN			
	YES	NO	NKRA	TOTAL
79-94-7 (Phenol, 4,4'-(1-methylethylidene)bis[2,6-dibromo-)	2	4		6
Building/construction materials not covered elsewhere		1		1
Electrical and electronic products	2	2		4
Industrial Manufacturing		1		1
POLYHALOGENATED CARBOCYCLES		5		5
115-27-5 (4,7-Methanoisobenzofuran-1,3-dione, 4,5,6,7,8,8-hexachloro-3a,4,7,7a-tetrahydro-)		2		2
Plastic and rubber products not covered elsewhere		1		1
Paints and coatings		1		1
13560-89-9 (1,4:7,10-Dimethanodibenzo[a,e]cyclooctene, 1,2,3,4,7,8,9,10,13,13,14,14-d odecachloro-1 ,4,4a,5,6,6a,7,10,10a,11,12,12a-dodecahydro-)		3		3
Building/construction materials not covered elsewhere		1		1
Electrical and electronic products		1		1
Plastic and rubber products not covered elsewhere		1		1
POLYHALOGENATED ORGANOPHOSPHATES		21	8	29
13674-84-5 (2-Propanol, 1-chloro-, 2,2',2"-phosphate)		14	5	19
Adhesives and sealants		2		2
Building/construction materials - wood and engineered wood products		1		1
Building/construction materials not covered elsewhere		8	1	9
Electrical and electronic products			1	1
Fabric, textile, and leather products not covered elsewhere			1	1
Flame retardant		1		1
Foam seating and bedding products			2	2
Insulating foam		1		1
Plastic and rubber products not covered elsewhere		1		1
13674-87-8 (2-Propanol, 1,3-dichloro-, 2,2',2"-phosphate)		1	1	2
Foam seating and bedding products			1	1
CBI		1		1
19186-97-1 (1-Propanol, 3-bromo-2,2-bis(bromomethyl)-, 1,1',1"-phosphate)		1		1
Plastic and rubber products not covered elsewhere		1		1
38051-10-4 (Phosphoric acid, P,P'-[2,2-bis(chloromethyl)-1,3-propanediyl] P,P,P',P'-tetrakis(2-chloroethyl) ester)		4		4
CBI		4		4
76025-08-6 (Phosphoric acid, bis(2-chloro-1-methylethyl) 2-chloropropyl ester)		1	2	3
Building/construction materials not covered elsewhere		1	1	2
Foam seating and bedding products			1	1
POLYHALOGENATED PHENOL DERIVATIVES		1		1
42757-55-1 (Benzene, 1,1'-sulfonylbis[3,5-dibromo-4-(2,3-dibromopropoxy)-)		1		1
Batteries		1		1
POLYHALOGENATED PHTHALATES/BENZOATES/IMIDES	3	13	1	17
183658-27-7 (Benzoic acid, 2,3,4,5-tetrabromo-, 2-ethylhexyl ester)	1			1
Foam seating and bedding products	1			1
20566-35-2 (1,2-Benzenedicarboxylic acid, 3,4,5,6-tetrabromo-, 1-[2-(2-hydroxyethoxy)ethyl] 2-(2-hydroxypropyl) ester)		3		3
Building/construction materials not covered elsewhere		3		3

OFR CLASS, CHEMICAL, AND PRODUCT USE	USE IN PRODUCTS INTENDED FOR CHILDREN			
	YES	NO	NKRA	TOTAL
26040-51-7 (1,2-Benzenedicarboxylic acid, 3,4,5,6-tetrabromo-, 1,2-bis(2-ethylhexyl) ester)	2	4		6
Electrical and electronic products	1	1		2
Fabric, textile, and leather products not covered elsewhere		1		1
Foam seating and bedding products	1			1
Plastic and rubber products not covered elsewhere		2		2
32588-76-4 (1H-Isoindole-1,3(2H)-dione, 2,2'-(1,2-ethanediyl)bis[4,5,6,7-tetrabromo-)		3		3
Adhesives and sealants		1		1
Building/construction materials not covered elsewhere		1		1
Electrical and electronic products		1		1
632-79-1 (1,3-Isobenzofurandione, 4,5,6,7-tetrabromo-)		3	1	4
Building/construction materials not covered elsewhere		1		1
Electrical and electronic products		1		1
Paints and coatings		1	1	2
POLYHALOGENATED DIPHENYL ETHERS		3		3
1163-19-5 (Benzene, 1,1'-oxybis[2,3,4,5,6-pentabromo-)		3		3
Fabric, textile, and leather products not covered elsewhere		2		2
Plastic and rubber products not covered elsewhere		1		1
POLYHALOGENATED TRIAZINES		1		1
25713-60-4 (1,3,5-Triazine, 2,4,6-tris(2,4,6-tribromophenoxy)-)		1		1
Plastic and rubber products not covered elsewhere		1		1
TOTAL	6	81	21	108

Source: U.S. EPA CDR (2016).
NKRA = Not known or reasonably ascertainable. This indicates the reporter did not know or could not ascertain the intended use.

A.18 MANUFACTURERS AND IMPORTERS – NUMBER OF REPORTS, 2011

NAS CATEGORY	MFG	IMP	BOTH	CBI	TOTAL
Polyhalogenated diphenyl ethers	3	2			5
Polyhalogenated alicycles	4	2			6
Polyhalogenated aliphatic chains	7	13	1		21
Polyhalogenated benzene aliphatics and functionalized	2	3			5
Polyhalogenated bisphenol aliphatics and functionalized	3	7			10
Polyhalogenated carbocycles		1		1	2
Polyhalogenated organophosphates	7	15			22
Polyhalogenated phenol derivatives	1				1
Polyhalogenated phenol-aliphatic ethers		1			1
Polyhalogenated phthalates/benzoates/imides	9	4			13
Polyhalogenated triazines; Polyhalogenated phenol derivatives		2			2
TOTAL	36	50	1	1	88
Source: U.S. EPA CDR (2012).					

A.19 TOTAL REPORTED MANUFACTURING AND IMPORT VOLUME, POUNDS, 2011 (AND 2010)

NAS CATEGORY	NO. OF REPORTS	SUM OF DOM_MFG_LB	SUM OF IMPORTED_LB	SUM OF PAST_PROD_VOLUME[1]
Polyhalogenated diphenyl ethers	5	542,112	-	251,733
Polyhalogenated alicycles	6	9,226,924	-	24,575,024
Polyhalogenated aliphatic chains	21	57,135,013	7,634,418	61,223,065
Polyhalogenated benzene aliphatics and functionalized	5	-	761,013	1,339,230
Polyhalogenated bisphenol aliphatics and functionalized	10	79,640	485,159	1,005,996
Polyhalogenated carbocycles	2	-	822,409	680,000
Polyhalogenated organophosphates	2	43,312,813	2,765,665	49,437,978
Polyhalogenated phenol derivatives	1	-	-	-
Polyhalogenated phenol-aliphatic ethers	1	-	-	-
Polyhalogenated phthalates/benzoates/imides	13	-	60,000	5,103,393
Polyhalogenated triazines; Polyhalogenated phenol derivatives	2	-	760,991	1,245,337
TOTAL	88	110,296,502	13,289,655	144,861,755
Source: U.S. EPA CDR (2012).				

[1] Per 2012 Instructions, this is for 2010 - verify

A.20 CONSUMER USE AND CHILD PRODUCT USE – NUMBER OF REPORTS, 2011

NAS CATEGORY	SUM OF REPORT COUNT	SUM OF COUNT OF CONSUMER USE	SUM OF COUNT OF CHILD PRODUCT USE
Polyhalogenated diphenyl ethers	5	25	5
Polyhalogenated alicycles	6	8	0
Polyhalogenated aliphatic carboxylate	0	0	0
Polyhalogenated aliphatic chains	21	22	0
Polyhalogenated benzene alicycles	0	0	0
Polyhalogenated benzene aliphatics and functionalized	5	25	0
Polyhalogenated benzene aliphatics and functionalized; Polyhalogenated phthalates/benzoates/imides	0	0	0
Polyhalogenated benzenes	0	0	0
Polyhalogenated bisphenol aliphatics and functionalized	10	10	0
Polyhalogenated carbocycles	2	4	0
Polyhalogenated carbocycles; Polyhalogenated benzene aliphatics and functionalized	0	0	0
Polyhalogenated organophosphates	22	50	0
Polyhalogenated phenol derivatives	1	0	0
Polyhalogenated phenol-aliphatic ethers	1	0	0
Polyhalogenated phthalates/benzoates/imides	13	19	0
Polyhalogenated triazines	0	0	0
Polyhalogenated triazines; Polyhalogenated phenol derivatives	2	0	0
TOTAL	88	163	5
Source: U.S. EPA CDR (2012).			

A.21 NUMBER OF REPORTS BY TYPE OF PROCESSING, 2011

NAS CATEGORY	TYPE OF PROCESSING - NO. OF REPORTS						
	PROCESSING AS A REACTANT	PROCESSING-INCORPORATION INTO ARTICLE	PROCESSING-INCORPORATION INTO FORMULATION, MIXTURE, OR REACTION PRODUCT	PROCESSING-REPACKAGING	USE-NON-INCORPORATIVE ACTIVITIES	NOT KNOWN OR REASONABLY ASCERTAINABLE	TOTAL
POLYHALOGENATED DIPHENYL ETHERS		2	10				12
Adhesives and sealant chemicals			1				1
Flame retardants		2	9				11
POLYHALOGENATED ALICYCLES	1	4	3				8
Flame retardants		2	3				5
Intermediates	1						1
Other (specify)		2					2
Polyhalogenated aliphatic chains		2	53		1	1	57
Adhesives and sealant chemicals		1	1				2
Flame retardants			40				40
Functional fluids (open systems)					1		1
Lubricants and lubricant additives			7				7
Paint additives and coating additives not described by other categories			3				3
Plasticizers		1	2				3
Not Known or Reasonably Ascertainable						1	1
POLYHALOGENATED BENZENE ALIPHATICS AND FUNCTIONALIZED			7			1	8
Corrosion inhibitors and anti-scaling agents			1				1
Flame retardants			6				6
Not Known or Reasonably Ascertainable						1	1
POLYHALOGENATED BISPHENOL ALIPHATICS AND FUNCTIONALIZED	1	1	4			1	7
Flame retardants	1	1	4				6
Not Known or Reasonably Ascertainable						1	1

NAS CATEGORY	TYPE OF PROCESSING – NO. OF REPORTS						
	PROCESSING AS A REACTANT	PROCESSING-INCORPORATION INTO ARTICLE	PROCESSING-INCORPORATION INTO FORMULATION, MIXTURE, OR REACTION PRODUCT	PROCESSING-REPACKAGING	USE-NON-INCORPORATIVE ACTIVITIES	NOT KNOWN OR REASONABLY ASCERTAINABLE	TOTAL
POLYHALOGENATED CARBOCYCLES			7	1		1	9
Flame retardants			7				7
Intermediates				1			1
Not Known or Reasonably Ascertainable						1	1
POLYHALOGENATED ORGANOPHOSPHATES	3		16		1		20
Adhesives and sealant chemicals			1				1
Flame retardants	1		15		1		17
Intermediates	2						2
POLYHALOGENATED PHENOL DERIVATIVES	1						1
Flame retardants	1						1
POLYHALOGENATED PHENOL-ALIPHATIC ETHERS	1						1
Flame retardants	1						1
POLYHALOGENATED PHTHALATES/BENZOATES/IMIDES	5		10		3		18
Flame retardants	3		8		1		12
Intermediates	2						2
Oxidizing/reducing agents					1		1
Plasticizers			2				2
Propellants and blowing agents					1		1
POLYHALOGENATED TRIAZINES; POLYHALOGENATED PHENOL DERIVATIVES			3				3
Corrosion inhibitors and anti-scaling agents			1				1
Flame retardants			1				1
Lubricants and lubricant additives			1				1
TOTAL	12	9	113	1	5	4	144
Source: U.S. EPA CDR (2012).							

A.22 NUMBER OF REPORTS BY INDUSTRIAL USE SECTOR, 2011

NAS Category	INDUSTRIAL USE SECTOR – NO. OF REPORTS																				
	Adhesive Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resins	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastics Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Utilities	Not Known or Reasonably Ascertainable	CBI	Total
Polyhalogenated diphenyl ethers	2					1							2	2	1	1	3				12
Polyhalogenated alicycles					2						1		3					2			8
Polyhalogenated aliphatic chains	8		6					1	1	9		7	1	10	7		6		1		57
Polyhalogenated benzene aliphatics and functionalized		1				1				1			4						1		8
Polyhalogenated bisphenol aliphatics and functionalized		1		1									3	1					1		7
Polyhalogenated carbocycles										1			1						1	6	9
Polyhalogenated organophosphates		1	1		7				2	2	2		3	1			1				20
Polyhalogenated phenol derivatives						1															1
Polyhalogenated phenol-aliphatic ethers														1							1
Polyhalogenated phthalates/ benzoates/imides	1	2	1		7	1	2		2				2								18
Polyhalogenated triazines; Polyhalogenated phenol derivatives													2	1							3
TOTAL	11	5	8	1	16	4	2	1	5	13	3	7	21	16	8	1	10	2	4	6	144
Source: U.S. EPA CDR (2012).																					

A.23 NUMBER OF REPORTS BY INDUSTRIAL FUNCTION CATEGORY, 2011

NAS Category	INDUSTRIAL FUNCTION CATEGORY – NO. OF REPORTS												
	Adhesives and Sealant Chemicals	Corrosion Inhibitors and Anti-Scaling Agents	Flame Retardants	Functional Fluids (Open Systems)	Intermediates	Lubricants and Lubricant Additives	Oxidizing/Reducing Agents	Paint Additives and Coating Additives Not Described by Other Categories	Plasticizers	Propellants and Blowing Agents	Other (Specify)	Not Known or Reasonably Ascertainable	Total
Polyhalogenated diphenyl ethers	1		11										12
Polyhalogenated alicycles			5		1						2		8
Polyhalogenated aliphatic chains	2		40	1		7		3	3			1	57
Polyhalogenated benzene aliphatics and functionalized		1	6									1	8
Polyhalogenated bisphenol aliphatics and functionalized			6									1	7
Polyhalogenated carbocycles			7		1							1	9
Polyhalogenated organophosphates	1		17		2								20
Polyhalogenated phenol derivatives			1										1
Polyhalogenated phenol-aliphatic ethers			1										1
Polyhalogenated phthalates/benzoates/imides			12		2		1		2	1			18
Polyhalogenated triazines; Polyhalogenated phenol derivatives		1	1			1							3
TOTAL	4	2	107	1	6	8	1	3	5	1	2	4	144
Source: U.S. EPA CDR (2012).													

A.24 NUMBER OF REPORTS BY PRODUCT CATEGORY, 2011

NAS Category	PRODUCT CATEGORY													
	Adhesives and Sealants	Building/Construction Materials - Wood and Engineered Wood Products	Building/Construction Materials Not Covered Elsewhere	Electrical and Electronic Products	Fabric, Textile, and Leather Products Not Covered Elsewhere	Floor Coverings	Foam Seating and Bedding Products	Furniture and Furnishings Not Covered Elsewhere	Paints and Coatings	Plastic and Rubber Products Not Covered Elsewhere	Other (Specify)	Not Known or Reasonably Ascertainable	NA	Total
Polyhalogenated diphenyl ethers	3	2		2	4	2				1				14
Polyhalogenated alicycles			4							2	1			7
Polyhalogenated aliphatic chains	1					1	1		3	2		1		9
Polyhalogenated benzene aliphatics and functionalized				4	1				2	3		1		11
Polyhalogenated bisphenol aliphatics and functionalized				3						3		1		7
Polyhalogenated carbocycles			1	1					2	2	1			7
Polyhalogenated organophosphates	1		10	1	1		4		1	1			2	21
Polyhalogenated phenol-aliphatic ethers										1				1
Polyhalogenated phthalates/benzoates/imides	2		8	6				2						18
Polyhalogenated triazines; Polyhalogenated phenol derivatives										2				2
TOTAL	7	2	23	17	6	3	5	2	8	17	2	3	2	97
Source: U.S. EPA CDR (2012).														

A.25 NUMBER OF REPORTS BY TYPE OF USE (COMMERCIAL OR CONSUMER), 2011

NAS CATEGORY	TYPE OF USE					
	COMMERCIAL	CONSUMER	BOTH	NOT KNOWN OR REASONABLY ASCERTAINABLE	NA	TOTAL
Polyhalogenated diphenyl ethers	9	5				14
Polyhalogenated alicycles	4	1	2			7
Polyhalogenated aliphatic chains	4		4	1		9
Polyhalogenated benzene aliphatics and functionalized	5	2	3	1		11
Polyhalogenated bisphenol aliphatics and functionalized	4	1	1	1		7
Polyhalogenated carbocycles	1		4	2		7
Polyhalogenated organophosphates	11	3	3	2	2	21
Polyhalogenated phenol-aliphatic ethers	1					1
Polyhalogenated phthalates/benzoates/imides	11	5	2			18
Polyhalogenated triazines; Polyhalogenated phenol derivatives	2					2
TOTAL	52	17	19	7	2	97
Source: U.S. EPA CDR (2012).						

A.26 NUMBER OF REPORTS BY TYPE OF USE (CHILDREN'S PRODUCTS), 2011

NAS CATEGORY	CHILDREN'S PRODUCTS USE				
	YES	NO	NOT KNOWN OR REASONABLY ASCERTAINABLE	NA	TOTAL
Polyhalogenated diphenyl ethers	1	13			14
Polyhalogenated alicycles		7			7
Polyhalogenated aliphatic chains		5	4		9
Polyhalogenated benzene aliphatics and functionalized		9	2		11
Polyhalogenated bisphenol aliphatics and functionalized		6	1		7
Polyhalogenated carbocycles		7			7
Polyhalogenated organophosphates		9	10	2	21
Polyhalogenated phenol-aliphatic ethers		1			1
Polyhalogenated phthalates/benzoates/imides		17	1		18
Polyhalogenated triazines; Polyhalogenated phenol derivatives		2			2
TOTAL	1	76	18	2	97
Source: U.S. EPA CDR (2012).					

A.27 NUMBER OF REPORTS BY AGGREGATE PRODUCTION VOLUME RANGE, 2005

NAS CATEGORY	AGGREGATE PRODUCTION VOLUME RANGE						
	< 500,000 LBS	500,000 TO < 1 MIL	1 MIL TO < 10 MIL	10 MIL TO < 50 MIL	50 MIL TO < 100 MIL	100 MIL TO < 500 MIL	TOTAL
Polyhalogenated diphenyl ethers					5		5
Polyhalogenated alicycles				7			7
Polyhalogenated aliphatic chains	2	1	2	12			17
Polyhalogenated benzene aliphatics and functionalized				1			1
Polyhalogenated bisphenol aliphatics and functionalized	1		2			5	8
Polyhalogenated carbocycles			2				2
Polyhalogenated organophosphates	2	3		9			14
Polyhalogenated phenol derivatives				2			2
Polyhalogenated phenol-aliphatic ethers	1	1	2				4
Polyhalogenated phthalates/benzoates/imides			5	2			7
TOTAL	6	5	13	33	5	5	67
Source: U.S. EPA CDR (2006).							

A.28 NUMBER OF CHILD USE REPORTS, 2005

NAS CATEGORY	NO. OF CHEMICALS IN CLASS	NO. OF CHILD USE REPORTS	NO. OF CHILD USE (CBI) REPORTS
Polyhalogenated diphenyl ethers	219	0	1
Polyhalogenated alicycles	22	0	1
Polyhalogenated aliphatic carboxylate	4	0	0
Polyhalogenated aliphatic chains	45	0	0
Polyhalogenated benzene alicycles	4	0	0
Polyhalogenated benzene aliphatics and functionalized	16	0	0
Polyhalogenated benzene aliphatics and functionalized; Polyhalogenated phthalates/benzoates/imides	1	0	0
Polyhalogenated benzenes	45	0	0
Polyhalogenated bisphenol aliphatics and functionalized	13	0	1
Polyhalogenated carbocycles	16	0	0
Polyhalogenated carbocycles; Polyhalogenated benzene aliphatics and functionalized	3	0	0
Polyhalogenated organophosphates	37	0	2
Polyhalogenated phenol derivatives	8	0	1
Polyhalogenated phenol-aliphatic ethers	11	0	1
Polyhalogenated phthalates/benzoates/imides	18	0	2
Polyhalogenated triazines	5	0	0
Polyhalogenated triazines; Polyhalogenated phenol derivatives	1	0	0
TOTAL	468	0	9
Source: U.S. EPA CDR (2006).			

A.29 NUMBER OF CHILD USE REPORTS, 2005, 2011, 2015

NAS CATEGORY	NO. OF CHILD USE REPORTS		
	2005	2011	2015
Polyhalogenated diphenyl ethers	0	**5**	0
1163-19-5 (1,1'-Oxybis[2,3,4,5,6-pentabromobenzene])	0	**5**	0
Polyhalogenated alicycles	0	0	0
Polyhalogenated aliphatic carboxylate	0	0	0
Polyhalogenated aliphatic chains	0	0	0
Polyhalogenated benzene alicycles	0	0	0
Polyhalogenated benzene aliphatics and functionalized	0	0	**1**
84852-53-9 (1,1'-Ethane-1,2-diylbis(pentabromobenzene))	0	0	**1**
Polyhalogenated benzene aliphatics and functionalized; Polyhalogenated phthalates/benzoates/imides	0	0	0
Polyhalogenated benzenes	0	0	0
Polyhalogenated bisphenol aliphatics and functionalized	0	0	**2**
79-94-7 (3,3',5,5'-Tetrabromobisphenol A)	0	0	**2**
Polyhalogenated carbocycles	0	0	0
Polyhalogenated carbocycles; Polyhalogenated benzene aliphatics and functionalized	0	0	0
Polyhalogenated organophosphates	0	0	0
Polyhalogenated phenol derivatives	0	0	0
Polyhalogenated phenol-aliphatic ethers	0	0	0
Polyhalogenated phthalates/benzoates/imides	0	0	**3**
26040-51-7 (Bis(2-ethylhexyl) tetrabromophthalate)	0	0	**2**
183658-27-7 (2-Ethylhexyl 2,3,4,5-tetrabromobenzoate)	0	0	**1**
Polyhalogenated triazines	0	0	0
Polyhalogenated triazines; Polyhalogenated phenol derivatives	0	0	0
TOTAL	0	5	6

A.30 NUMBER OF REPORTS BY USE NAICS CODE, 2005

NAS CATEGORY	NAICS CODE																								
	31331	32419	32519	32521	32551	32552	32559	32599	32611	32614	32615	32622	33210	33411	33441	33522	33593	33611	33712	42399	42461	42469	CBI	TOTAL
Polyhalogenated diphenyl ethers	1					1		1						1		1	1	1					1	8
Polyhalogenated alicycles	1		1							3													1	6
Polyhalogenated aliphatic chains		3	1	1		1						5	1							1				13
Polyhalogenated benzene aliphatics and functionalized								1						1	1		1	1						5
Polyhalogenated bisphenol aliphatics and functionalized								1						1	1						1		3	7
Polyhalogenated carbocycles				1	1																		1	3
Polyhalogenated organophosphates				1			1	1			2							1	1			1	5	13
Polyhalogenated phenol derivatives																							1	1
Polyhalogenated phenol-aliphatic ethers																							2	2
Polyhalogenated phthalates/benzoates/imides			2	2				4	1		1			1			2						2	15
TOTAL	2	3	4	5	1	2	1	8	1	3	3	5	1	4	2	1	4	3	1	1	1	1	16	73

NAICS CODE DESCRIPTIONS

31331	Textile and Fabric Finishing Mills
32419	Other Petroleum and Coal Products Manufacturing
32519	Other Basic Organic Chemical Manufacturing
32521	Resin and Synthetic Rubber Manufacturing
32541	Pharmaceutical and Medicine Manufacturing
32551	Paint and coating manufacturing
32552	Adhesive Manufacturing
32559	Invalid NAICS
32599	All Other Chemical Product and Preparation Manufacturing
32611	Plastics Packaging Materials and Unlaminated Film and Sheet Manufacturing
32614	Polystyrene Foam Product Manufacturing
32615	Urethane and Other Foam Product (except Polystyrene) Manufacturing
32622	Rubber and Plastics Hoses
33210	Forging and Stamping
33411	Computer and peripheral equipment manufacturing
33441	Semiconductor and Other Electronic Component Manufacturing
33522	Major Household Appliance Manufacturing
33593	Wiring Device Manufacturing
33611	Automobile and Light Duty Motor Vehicle Manufacturing
33712	Household and Institutional Furniture Manufacturing
42399	Other Miscellaneous Durable Goods Merchant Wholesalers
42461	Plastics Materials and Basic Forms and Shapes Merchant Wholesalers
42469	Chemical and Allied Products Merchant Wholesalers

Source: U.S. EPA CDR (2006).

A.31 NUMBER OF REPORTS BY PROCESS CODE, 2005

NAS CATEGORY	PROCESS CODE							
	PROCESSING AS A REACTANT	PROCESSING—INCORPORATION INTO FORMULATION, MIXTURE, OR REACTION PRODUCT	PROCESSING—INCORPORATION INTO ARTICLE	PROCESSING—REPACKAGING	USE—NON-INCORPORATIVE ACTIVITIES	NOT READILY OBTAINABLE	CBI	TOTAL
Polyhalogenated diphenyl ethers		1	6				1	8
Polyhalogenated alicycles	1	1	3				1	6
Polyhalogenated aliphatic chains	1	9	1		1	1		13
Polyhalogenated benzene aliphatics and functionalized		1	4					5
Polyhalogenated bisphenol aliphatics and functionalized		2	1				4	7
Polyhalogenated carbocycles		3						3
Polyhalogenated organophosphates		3	3	1	1		5	13
Polyhalogenated phenol derivatives							1	1
Polyhalogenated phenol-aliphatic ethers							2	2
Polyhalogenated phthalates/benzoates/imides	2	4	6	1			2	15
TOTAL	4	24	24	2	2	1	16	73
Source: U.S. EPA CDR (2006).								

A.32 NUMBER OF REPORTS BY INDUSTRIAL FUNCTION, 2005

NAS CATEGORY	INDUSTRIAL FUNCTION									
	ADHESIVES AND BINDING AGENTS	FLAME RETARDANTS	FLOTATION AGENTS	FUNCTIONAL FLUIDS	INTERMEDIATES	LUBRICANTS	NOT READILY OBTAINABLE	OTHER	CBI	TOTAL
Polyhalogenated diphenyl ethers		7							1	8
Polyhalogenated alicycles		3			1			1	1	6
Polyhalogenated aliphatic chains	1	6		1		3	1	1		13
Polyhalogenated benzene aliphatics and functionalized		5								5
Polyhalogenated bisphenol aliphatics and functionalized		4							3	7
Polyhalogenated carbocycles		3								3
Polyhalogenated organophosphates		7	1						5	13
Polyhalogenated phenol derivatives									1	1
Polyhalogenated phenol-aliphatic ethers									2	2
Polyhalogenated phthalates/ benzoates/imides		12			1				2	15
TOTAL	1	47	1	1	2	3	1	2	15	73
Source: U.S. EPA CDR (2006).										

A.33 NUMBER OF REPORTS BY PRODUCT CATEGORY, 2005

NAS CATEGORY	PRODUCT CATEGORY								
	ADHESIVES AND SEALANTS	ELECTRICAL AND ELECTRONIC PRODUCTS	FABRICS, TEXTILES AND APPAREL	NOT READILY OBTAINABLE	PAINTS AND COATINGS	RUBBER AND PLASTIC PRODUCTS	OTHER	NA	TOTAL
Polyhalogenated diphenyl ethers	1	1	1			1		1	5
Polyhalogenated alicycles			1			2		1	4
Polyhalogenated aliphatic chains	1	1		1		1	1		5
Polyhalogenated benzene aliphatics and functionalized		1				1			2
Polyhalogenated bisphenol aliphatics and functionalized		1					1	2	4
Polyhalogenated carbocycles		1			1	1			3
Polyhalogenated organophosphates						4		3	7
Polyhalogenated phenol derivatives								1	1
Polyhalogenated phenol-aliphatic ethers								1	1
Polyhalogenated phthalates/benzoates/imides		2				3	1	2	8
TOTAL	2	7	2	1	1	13	3	11	40
Source: U.S. EPA CDR (2006).									

A.34 NUMBER OF REPORTS BY PRODUCTION VOLUME RANGE, 1997

NAS CATEGORY	PRODUCTION VOLUME RANGE						
	10K - 500K	>500K - 1M	>1M - 10M	>10M - 50M	>50M - 100M	>100M - 500M	TOTAL
Polyhalogenated diphenyl ethers	1		3		1		5
Polyhalogenated alicycles	2			2			4
Polyhalogenated aliphatic chains	3		2	2			7
Polyhalogenated benzenes	1						1
Polyhalogenated bisphenol aliphatics and functionalized	1		2			1	4
Polyhalogenated carbocycles	1		2				3
Polyhalogenated organophosphates	5		5	3			13
Polyhalogenated phenol derivatives				1			1
Polyhalogenated phenol-aliphatic ethers	1	1	1				3
Polyhalogenated phthalates/benzoates/imides			2	2			4
TOTAL	15	1	17	10	1	1	45
Source: U.S. EPA CDR (1998).							

A.35 TOXIC RELEASE INVENTORY REPORTS AND PRODUCTION-RELATED WASTE MANAGED (POUNDS), 2015-2019

CHEMICAL ID	CHEMICAL NAME	PRODUCTION-RELATED WASTE (POUNDS)					NUMBER OF REPORTS				
		2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
1163-19-5	1,1'-Oxybis[2,3,4,5,6-pentabromobenzene]	463,003	517,297	250,060	155,428	146,017	30	24	17	16	11
126-72-7	Tris(2,3-dibromopropyl) phosphate	14	20,477	18,410	16,669	15,748	1	1	1	1	1
2234-13-1	1,2,3,4,5,6,7,8-Octachloronaphthalene					-					1
25637-99-4	Hexabromocyclododecane			724	4	132,266			4	1	3
3296-90-0	Pentaerythritol dibromide	94	875	2,428	1,294	1,121	2	2	2	3	3
59536-65-1	Polybrominated biphenyls (PBB)					1,449					1
77-47-4	Hexachlorocyclopentadiene	111,152	101,178	81,419	74,694	127,680	8	8	6	5	6
79-94-7	3,3',5,5'-Tetrabromobisphenol A	294,082	208,899	133,435	141,977	2,452,031	56	58	54	50	54
85535-84-8	C10-13 chloro alkanes	213,979	156,953	56,374	171,530	68,255	7	4	2	9	6
TOTAL		1,082,324	1,005,679	542,850	561,595	2,944,567	104	97	86	85	86
Source: U.S. EPA Toxic Release Inventory, 2015-2019.											

APPENDIX B | GUIDE TO SUMMARY EXHIBIT FOR EACH CLASS

B.1 GUIDE TO SUMMARY TABLES

Each class-based appendix (Appendix C through Appendix P) contains a summary exhibit which lists the chemicals in the class and scores or findings from different data sources gathered throughout the project. The table begins with a first row which counts how many of the chemicals in the class have results for the given field. The definitions and derivations of the fields are shown below. Additional information on the underlying values is provided in Chapter 2 and 3 of the main report, with class-specific details in each class-based Appendix.

Field Name	Explanation of Contents
CAS Number	Chemical Abstracts Service identifier.
Chemical Name	Assigned Chemical Name as determined by CPSC.
Synonyms	Common synonyms of the chemical, manually selected from values found in PubChem and EPA's CompTox dashboard.
CDR, TSCA (Active), TRI, or HPCDS	Point-based. Indicative of current industrial activity and presence in materials of concern. One point for presence in CDR Production Volume (Manufacturing and Importing) between 2010-2015. One point for presence on the current TSCA registry as an Active substance. One point for presence on EPA's Toxics Release Inventory. One point for presence on the High Priority Chemicals Data System, with an additional 0.5 if the chemical is reported at a concentration greater than or equal to 0.1 percent. Color scale set based on entire dataset through Excel's conditional formatting feature using a two-color scale based on minimum and maximum values (i.e., gradient from no fill at zero to green at the highest value, transitioning through peach for middle values automatically).
TSCA (Inactive) or Int'l Registries	Point-based. Indicative of potential or past use in commerce. One point for presence on the current TSCA registry as an Inactive substance. One point if the chemical is found on any of the five international registries evaluated (see Exhibit B-1 for registry details). Color scale set based on entire dataset through Excel's conditional formatting feature using a two-color scale based on minimum and maximum values (i.e., gradient from no fill at zero to green at the highest value, transitioning through peach for middle values automatically).
Literature Review Sources	Number of sources from the Targeted Literature Review which referenced the chemical. See details within each class-based appendix and additional methodology in Section 3.2.6 of the main report. Color scale set based on entire dataset through Excel's conditional formatting feature using a two-color scale based on minimum and maximum values (i.e., gradient from no fill at zero to green at the highest value, transitioning through peach for middle values automatically).
Initial Data Source Score	High-Medium-Low score indicating potential for use as a flame retardant in commerce given to each chemical based on CPSC initial review of U.S. and international reports on flame retardants and key literature (see Section 3.2.1 of the main report for details). Color scale set through Excel's conditional formatting feature using no fill for cell values equal to "low," grey for cell values equal to "med," and green for cell values equal to "high."

Field Name	Explanation of Contents
OFR QSUR Score	Quantitative Structure-Use Relationship (QSUR) score provided for most chemicals indicating similarity in structure to known OFRs and likelihood of potential use as an OFR through similar chemistry. Provided by U.S. EPA. Color scale set based on entire dataset through Excel's conditional formatting feature using a three-color scale based on the minimum value, 50th percentile, and maximum value (i.e., gradient from no fill at zero to green at the highest value, transitioning through grey for values around the 50th percentile).
Total Count of Patents	Total count of patents returned from a search of the associated Compound Identifier (CID) in PubChem. If chemicals were not associated with a CID, "No CID" is reported and no value appears in the following two fields. Color scale set based on entire dataset through Excel's conditional formatting feature using a three-color scale based on the minimum value, 50th percentile, and maximum value (i.e., gradient from no fill at zero to green at the highest value, transitioning through grey for values around the 50th percentile).
% Post-2000 Patents	Percent of patents that are recent, defined as a priority data of 2001 or later. Color scale set based on entire dataset through Excel's conditional formatting feature using a three-color scale based on the minimum value, 50th percentile, and maximum value (i.e., gradient from no fill at zero to green at the highest value, transitioning through grey for values around the 50th percentile).
% Post-2000 Patents with OFR Keywords in Abstract	Percent of recent patents that contain any of the designated OFR keywords in the patent abstract. The OFR keywords/phrases are: "flame retard|flame-retard|flameproof|flame-resist|fire retard|fire-retard|fireproof|fire resist|fire-resist|BFR|OFR." Color scale set based on entire dataset through Excel's conditional formatting feature using a three-color scale based on the minimum value, 50th percentile, and maximum value (i.e., gradient from no fill at zero to green at the highest value, transitioning through grey for values around the 50th percentile).
U.S./ Int'l Regulatory Lists	Presence of chemical on any of the state, U.S., or international regulatory lists identified in Appendix Q. Color scale set through Excel's conditional formatting feature using no fill for blank cells, grey for cell values between zero and five, and green for cell values greater than 5.

APPENDIX C POLYHALOGENATED ALICYCLES CLASS SYNTHESIS

C.1 SUMMARY BY CHEMICAL – PHAS

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S. / INT'L REGULATORY LISTS
All	**Across all 22 PHAs**		**4**	**18**	**13**	**NA**	**22**	**19**	**NA**	**NA**	**15**
1093632-34-8	1,3,5,7,9,11-Hexabromocyclododecane	Cyclododecane, hexabromo-	0	0	1	low	0.8839	20	95%	67%	1
134237-50-6	(+/-)-?-Hexabromocyclododecane	alpha-HBCD	0	1	2	high	0.9376	37	84%	100%	2
134237-51-7	(+/-)-beta-Hexabromocyclododecane	beta-HBCD	0	1	4	high	0.9376	34	82%	100%	2
134237-52-8	(+/-)-gamma-Hexabromocyclododecane	gamma-HBCD	0	1	5	high	0.9376	2,286	87%	86%	2
138257-18-8	(-)-beta-Hexabromocyclododecane	beta-HBCD	0	1		med	0.9376	34	82%	100%	1
138257-19-9	(+)-alpha-Hexabromocyclododecane	alpha-HBCD	0	1	2	med	0.9376	2	100%		1
169102-57-2	(1R,2S,5S,6S,9S,10R)-1,2,5,6,9,10-Hexabromocyclododecane		0	1		med	0.9376	1	100%		1
1837-91-8	Benzene hexabromide		0	1		med	0.871	336	70%	57%	
25495-98-1	Cyclodecane, hexabromo		0	0	2	high	0.8674	2,064	70%	78%	
25637-99-4	Hexabromocyclododecane	HBCD (mixture)	4.5	1	6	high	0.8839	17,391	74%	75%	13
26657-83-0	pentabromocyclododecene		0	0		low	0.9418	No CID			
30178-92-8	1,1,2,2-Tetrabromocyclododecane		0	0		low	0.7071	12	8%	20%	
30554-73-5	Tribromotrichlorocyclohexane		0	2		low	0.8405	No CID			
31454-48-5	1,3,5,7-Tetrabromocyclooctane		0	1	1	low	0.8839	No CID			
3194-55-6	1,2,5,6,9,10-Hexabromocyclododecane	HBCD (isomer)	2	1	22	high	0.9376	5,179	73%	73%	6
3194-57-8	1,2,5,6-Tetrabromocyclooctane		0	1	7	high	0.9376	88	30%	60%	

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S. / INT'L REGULATORY LISTS
3322-93-8	1,2-Dibromo-4-(1,2-dibromoethyl)cyclohexane	Saytex BCL 462	0	2	8	high	0.9313	853	83%	61%	1
678970-15-5	(-)-alpha-Hexabromocyclododecane	alpha-HBCD	0	1		med	0.9376	37	84%	100%	1
678970-16-6	(+)-beta-Hexabromocyclododecane	beta-HBCD	0	1		med	0.9376	1	100%		1
678970-17-7	(+)-gamma-Hexabromocyclododecane	gamma-HBCD	0	1		med	0.9376	2,286	87%	86%	1
77-47-4	Hexachlorocyclopentadiene	Graphlox; Perchlorocyclopentadiene; HCCPD	3	1	2	high	0.7712	5,554	41%	53%	1
87-84-3	Pentabromochlorocyclohexane		1	1	2	high	0.871	340	76%	45%	1

C.1.1 OVERVIEW

There are 22 substances in the OFR class "Polyhalogenated Alicycles" (PHAs), with key attributes described in the Summary by Chemical table (For field definitions and color scheme, see Guide to Summary Tables, Appendix B.1). Seventeen of these substances are reported on one or more chemical inventories we reviewed. Of these, four are active TSCA Inventory[2] substances and another three are inactive. All four active substances and two of the three inactive substances also appear on non-U.S. inventories. Eleven additional substances not on the TSCA Inventory (active or inactive) appear on international registries. Four remaining PHAs do not appear on any other international inventories reviewed.

During our literature search, we found that while some of the PHA chemicals found on the TSCA active inventory are referenced in the literature, others are not. In our literature search, we were able to collect data for four PHAs on the TSCA active inventory, one inactive PHA, and six PHAs identified on other inventories. Patent data from PubChem reported information on 19 PHA chemicals.

The majority of chemicals in this class are derivatives of hexabromocyclododecane, HBCD. The primary industrial mixture (CAS No. 25637-99-4) contains multiple isomers and stereoisomers of the PHA class[3]. In particular, many of the stereoisomers are not produced industrially but are primarily identified in environmental or human health studies, as demonstrated in the literature review.

C.1.2 INDUSTRY PRODUCTION AND USE

Most of the available information from EPA focuses on three of the 22 PHA chemicals, which are all active TSCA Inventory substances. CAS No. 77-47-4 accounts for most of the current production (manufacturing or importing) activity in the United States within this OFR class.

For the most recent year available from EPA, 2015, U.S. industry reported manufacturing and importing PHAs into the United States. Specifically, industry submitted 10 reports of manufacturing activity (one each for CAS Nos. 25637-99-4 and 3194-55-6), six reports of importing activity (CAS Nos. 3194-55-6 [3 reports], 25637-99-4 [2 reports], and 77-47-4 [1 report]), and two additional reports where the activity was not specified or was claimed as CBI.

In the literature, several PHA chemicals (CAS Nos. 25495-98-1, 25637-99-4, 3194-55-6, and 77-47-4) have been characterized as high production volume chemicals. CAS Nos. 77-47-4 and 3194-55-6 have been manufactured or imported in the United States at high volumes for many years.

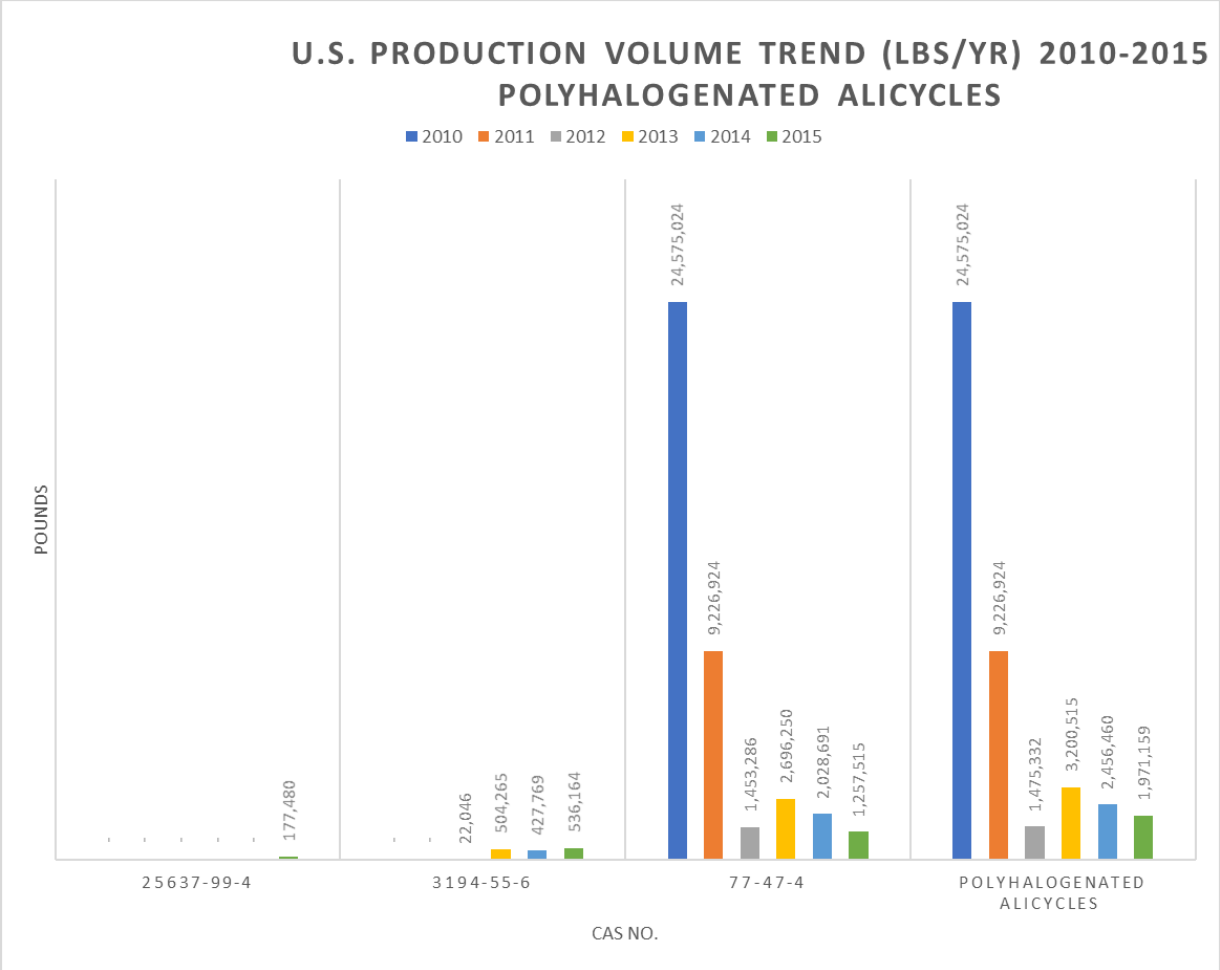
Total reported production volume (manufacturing plus importing) in 2015 included 1.3 million pounds for CAS No. 77-47-4, 536,000 pounds for CAS No. 3194-55-6, and 177,000 pounds for CAS No. 25637-99-4.

Production volume (PV) trend data for 2010-2015 indicates the combined PV for reported substances average 7.1 million pounds per year. Reported production volumes for this OFR subclass declined in

[2] The Toxic Substances Control Act (TSCA) Inventory is a list of chemical substances manufactured in or imported to the United States at some time since June 2006. For more information see https://www.epa.gov/tsca-inventory/tsca-inventory-notification-active-inactive-rule

[3] Isomers are chemicals with the same molecular constitution, but different attachment patterns of the atoms (i.e., chemical anagrams). Stereoisomers have the same attachment patterns, but different three-dimensional presentations (e.g., mirror images or rotations at different central atoms).

2011 and 2012. Between 2012 and 2015, production volumes of polyhalogenated alicycles were reported to be around 2 million pounds per year, on average.



Source: U.S. EPA, CDR (2011-2016).

Data from EPA indicate that PVs of PHA chemicals have decreased over time and that these chemicals were produced in larger quantities in prior reporting periods. In 2012, industry reported a total PV of 24.6 million pounds, while in 2006 there were seven reports submitted, each with PV in the 10 to 50 million pound range.

Industry identified 15 processing and use activities for PHA substances in 2015, of which 12 involved processing or use as a flame retardant. From industry reporting to EPA, uses as a flame retardant included:

- Construction (8 reports)
- Plastic material and resin manufacturing (3 reports)
- Plastics product manufacturing (1 report)

A single report each for CAS Nos. 25637-99-4 and 3194-55-6 identified a consumer use, but no reports identified a children's product use. This is not consistent with product testing data found in the literature search and with reporting from the HPCDS, which indicate PHAs are used in variety of consumer

products, baby car/ booster seats, fancy dress accessories, and non-powered toy vehicles. Gaps in information within the supply chain, however, may make it difficult for industry to know or reasonably ascertain if hazardous chemicals are or will be used in consumer or children's products.

Over the period 2015-2019, industry has submitted between six and 10 reports each year (41 reports total) under the Toxics Release Inventory (TRI) for CAS No. 25637-99-4. The use classifications for the chemical was included on 12 of these 41 reports, and were as follows:

- 3.2A:P102 Processing as a reactant / raw materials (2 reports)
- 3.2B:P201 Processing as a formulation component / additives (4 reports)
- 3.3C:Z306 Otherwise use: ancillary or other use / waste treatment(4 reports)
- 3.3C:Z399 Otherwise use: ancillary or other use / other (2 reports)

TRI reports indicate the waste volume managed for this chemical fluctuated between 75,000 and 260,000 pounds per year for 2016-2019, averaging 125,000 pounds per year over this period. Most of these reports (29 of 41) were from the chemicals industry, with additional reports submitted by the nonmetallic minerals (5 reports), hazardous waste (4 reports) and plastics and other (2 reports) industries.

C.1.3 USE IN CONSUMER AND CHILDREN'S PRODUCTS

The states of Washington and Oregon require industry to report on chemicals of concern in products intended for use by children that are sold in those states. The reporting tool used by Washington and Oregon is known as the High Priority Chemicals Data System (HPCDS). According to data available from the HPCDS, manufacturers have reported the use of potentially hazardous PHAs in children's products.

Over the period 2013-2020, 126 reports were submitted for one PHA, HBCD (CAS No. 25637-99-4); 63 of these reports indicated the chemical function in each product was "flame retardant" and three of these reported the concentration in the final product exceeded 0.1 percent. Children's products falling into this group included baby car/booster seats, fancy dress accessories (non-powered), and toy vehicles - non-ride (non-powered). The presence of HBCD was reported in these components and materials of children's products:

- Synthetic polymers (synthetic rubber, plastics, foams, etc.); and
- Surface coatings (paints, plating, waterproofing, etc.).

PHAs have been cited in 32 of the 70 literature sources reviewed. Among the 13 PHAs cited, chemicals appearing in the greatest number of these sources include: CAS No. 3194-55-6 (22 sources), CAS No. 3322-93-8 (8 sources) and CAS No. 3194-57-8 (7 sources). Several sources report the results of product testing, and these indicate PHAs have been found in a variety of consumer and/or children's products, such as (reported concentrations in products shown in parentheses):

- Flexible polyurethane foams (0 to 15 percent)
- Upholstery fabric (6 to 15 percent)
- Expanded polystyrene (0 to 2 percent)
- Textile backing (10 to 25 percent)

- High impact polystyrene (1 to 7 percent)
- Child car seat foam (no concentration indicated)

Uses for PHAs identified through the literature review (as described in Chapter 3) include:

CAS No. 1093632-34-8: polystyrene foam in building insulation

CAS No. 25637-99-4: insulation boards for buildings and construction; high-impact polystyrene in electronics and appliances; EPS and XPS resins for building and construction materials; floormats, roof interior coverings, and other interior fabrics of motor vehicles. In Europe EPS may be used in child car seats or for insulation for transport vehicles.

CAS No. 3194-55-6: curtains; insulation boards for construction, HIPS resin in electronics, appliances, and possibly textiles; EXP/XPS for building industry rigid insulation panels or boards; textiles coatings in upholstered furniture; flame retardant in expanded (EPS) and extruded (XPS) polystyrene foams for thermal insulation materials; binders, paints, HIPS plastic, and electronic housing.

CAS No. 3194-57-8: curtains.

CAS No. 3322-93-8: curtains; high-impact plastic parts of appliances, thermal insulation in houses, polystyrene foam, adhesives in fabric/vinyl, and electric cable coating; textiles.

C.2 PHAS ON NATIONAL AND INTERNATIONAL INVENTORIES AND REGISTRIES

Chemicals in class: 22

- 4 active on TSCA Inventory (recently manufactured/imported in U.S.)[4]
- 3 inactive on TSCA Inventory (no longer manufactured/imported in U.S.)
- 15 not on TSCA Inventory (never manufactured/imported in U.S.)

PHAS ON THE TSCA ACTIVE INVENTORY	
77-47-4	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-
87-84-3	Cyclohexane, 1,2,3,4,5-pentabromo-6-chloro-
3194-55-6	Cyclododecane, 1,2,5,6,9,10-hexabromo-
25637-99-4	Cyclododecane, hexabromo-
PHAS ON THE TSCA INACTIVE INVENTORY	
1837-91-8	Cyclohexane, 1,2,3,4,5,6-hexabromo-
3322-93-8	Cyclohexane, 1,2-dibromo-4-(1,2-dibromoethyl)-
30554-73-5	Cyclohexane, tribromotrichloro-

Source: U.S. EPA, CDR (2016).

OTHER PHAS ON INTERNATIONAL REGISTRIES		
134237-50-6	(+/-)-α-Hexabromocyclododecane	Japan CSCL
134237-51-7	(+/-)-beta-Hexabromocyclododecane	Japan CSCL
134237-52-8	(+/-)-gamma-Hexabromocyclododecane	Japan CSCL
138257-18-8	(-)-beta-Hexabromocyclododecane	Japan CSCL
138257-19-9	(+)-alpha-Hexabromocyclododecane	Japan CSCL
169102-57-2	(1R,2S,5S,6S,9S,10R)-1,2,5,6,9,10-Hexabromocyclododecane	Japan CSCL
31454-48-5	1,3,5,7-Tetrabromocyclooctane	Japan CSCL
3194-57-8	1,2,5,6-Tetrabromocyclooctane	Japan CSCL, China IECSC
678970-15-5	(-)-alpha-Hexabromocyclododecane	Japan CSCL
678970-16-6	(+)-beta-Hexabromocyclododecane	Japan CSCL
678970-17-7	(+)-gamma-Hexabromocyclododecane	Japan CSCL

Source: U.S. EPA, CDR (2016).

[4] "Active" indicates that U.S. manufacturing or importing activity has been reported since June 2006.

C.3 U.S. MANUFACTURING AND IMPORTING ACTIVITY, 2015

NUMBER OF REPORTS BY ACTIVITY TYPE						
PHAS	MANUFACTURE	IMPORT	BOTH MANUFACTURE AND IMPORT	NOT SPECIFIED	CBI	TOTAL
25637-99-4	1	2			1	4
3194-55-6	1	3			1	5
77-47-4		1				1
Totals	**2**	**6**			**2**	**10**

Source: U.S. EPA, CDR (2016).

C.4 U.S. MANUFACTURING AND IMPORTING VOLUMES, 2015

REPORTED VOLUMES BY ACTIVITY TYPE					
PHAS	MANUFACTURE	IMPORT	PRODUCTION VOLUME (MANUFACTURE + IMPORT)	USED	EXPORTED
25637-99-4	177,480	177,480	-	-	
3194-55-6	536,164	536,164	202,647	333,517	
77-47-4	1,257,515	1,257,515	-	1,257,515	
Totals	**-**	**1,971,159**	**1,971,159**	**202,647**	**1,591,032**

-- data CBI or otherwise not disclosed
Source: U.S. EPA, CDR (2016).

C.5 U.S. PRODUCTION VOLUME TRENDS, 2012-2015

PHAS	PV 2015	PV 2014	PV 2013	PV 2012
25637-99-4	177,480	-	-	-
3194-55-6	536,164	427,769	504,265	22,046
77-47-4	1,257,515	2,028,691	2,696,250	1,453,286
Totals	**1,971,159**	**2,456,460**	**3,200,515**	**1,475,332**

-- data CBI or otherwise not disclosed
PV = manufacturing plus importing
Source: U.S. EPA, CDR (2016).

C.6 TYPE OF PROCESSING OR USE REPORTS, 2015

NUMBER OF REPORTS								
PHAS	Processing as a Reactant	Processing—Incorporation Into Article	Processing—Incorporation Into Formulation, Mixture, or Reaction Product	Processing—Repackaging	Use—Non-Incorporative Activities	CBI	NKRA	Grand Total
25637-99-4		3	4					7
3194-55-6	1	4	1					6
77-47-4	1		1					2
Totals	**2**	**7**	**6**					**15**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

C.7 INDUSTRIAL USE REPORTS, 2015

NUMBER OF REPORTS																								
PHAS	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
25637-99-4						4										2	1							7
3194-55-6		1				5																		6
77-47-4														1		1								2
Total		**1**				**9**								**1**		**3**	**1**							**15**
USED AS FLAME RETARDANT																								
25637-99-4					3						2	1					6							
3194-55-6					5												5							
77-47-4											1						1							
Totals					**8**						**3**	**1**					**12**							

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

C.8 INDUSTRIAL FUNCTION REPORTS, 2015

NUMBER OF REPORTS															
PHAS	Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Other	Paint Additives and Coating Additives Not Described by Other Categories	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	CBI	NKRA	Grand Total
25637-99-4				6				1							7
3194-55-6				5		1									6
77-47-4				1		1									2
Totals				**12**		**2**		**1**							**15**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

C.9 INDUSTRIAL SECTOR REPORTS, 2015

NUMBER OF REPORTS																							
PHAS	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
ALL INDUSTRIAL FUNCTIONS																							
Total		**1**				**9**								**1**		**3**	**1**						**15**
25637-99-4						4										2	1						7
3194-55-6		1				5																	6
77-47-4														1		1							2
USED AS FLAME RETARDANT																							
Total						**8**										**3**	**1**						**12**
25637-99-4						3										2	1						6
3194-55-6						5																	5
77-47-4																1							1

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

C.10 CONSUMER AND CHILDREN'S PRODUCT USE REPORTS, 2015

NUMBER OF REPORTS						
PHAS	COMMERCIAL	CONSUMER	CONSUMER AND COMMERCIAL	NKRA	CBI	TOTAL
25637-99-4	4		1			5
3194-55-6	1	1				2
77-47-4	2					2
Totals	**7**	**1**	**1**			**9**

NKRA = not known or reasonably ascertainable
Reports for 25637-99-4 and 3194-55-6 were for use in building/construction materials not covered elsewhere.
Source: U.S. EPA, CDR (2016).

PHAS	CHILDREN'S PRODUCT USE	NKRA	OTHER USE	TOTAL
25637-99-4			5	5
3194-55-6			2	2
77-47-4			2	2
Totals			**9**	**9**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

C.11 TOXIC RELEASE INVENTORY REPORTS

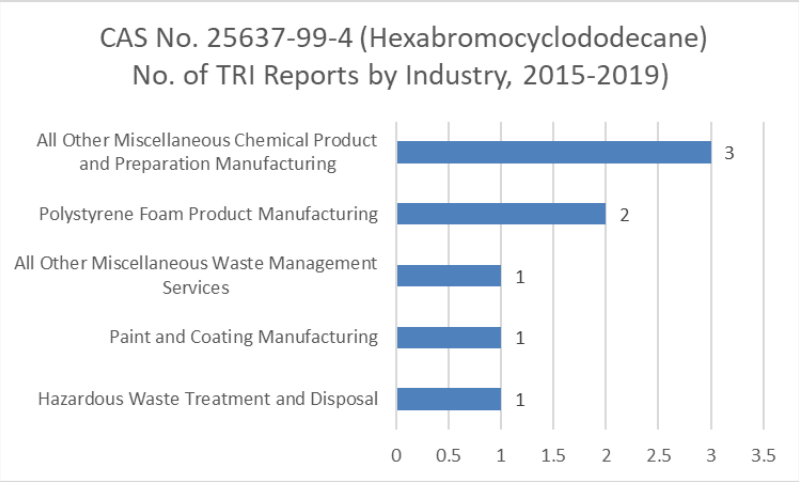
TRI-REPORTABLE CHEMICALS	
25637-99-4	Hexabromocyclododecane
77-47-4	Hexachlorocyclopentadiene

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

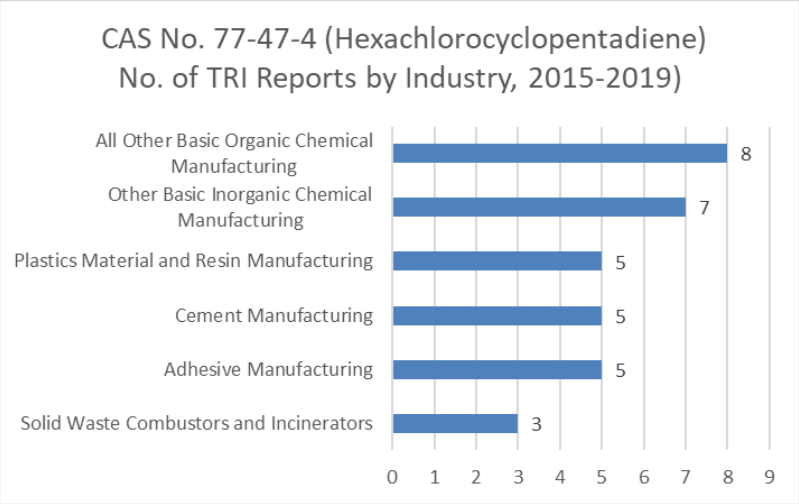
TOTAL PRODUCTION-RELATED WASTE REPORTED							
PHAS		2015	2016	2017	2018	2019	TOTAL
25637-99-4	No. of Reports			4	1	3	**8**
	Pounds of waste managed			724	4	132,266	**132,994**
77-47-4	No. of Reports	8	8	6	5	6	**33**
	Pounds of waste managed	111,152	101,178	81,419	74,694	127,680	**496,122.26**

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TRI REPORTS BY INDUSTRY



Source: U.S. EPA, Toxics Release Inventory (2015-2019).



Source: U.S. EPA, Toxics Release Inventory (2015-2019).

C.12 HIGH PRIORITY CHEMICALS DATA SYSTEM REPORTS

NUMBER OF REPORTS BY YEAR											
PHAS		2012	2013	2014	2015	2016	2017	2018	2019	2020[1]	TOTAL
25637-99-4	Total		2	16	1	29	63	4	8	3	126
	FR					2	59	1	1		63
	Conc>0.1%					2		1			3

[1] Partial year reporting.
Source: Interstate Chemicals Clearinghouse (2021).

Products include: baby car/booster seats, fancy dress accessories, and toy vehicles - non-ride, non-powered.

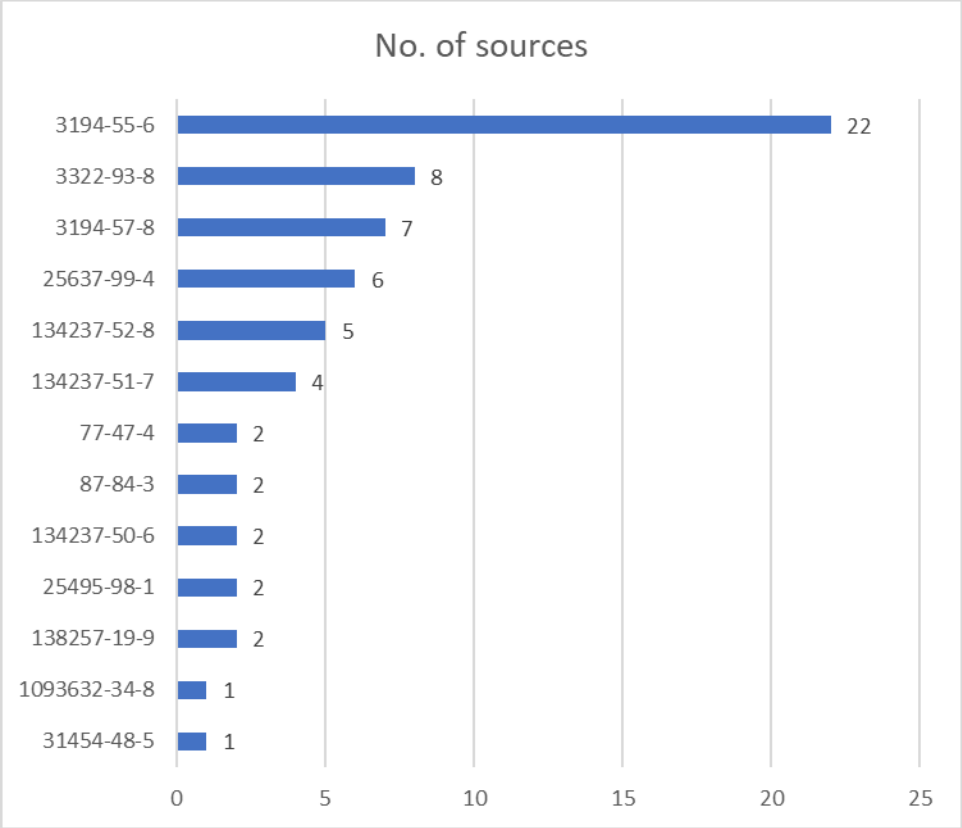
C.13 PATENT COUNTS FROM PUBCHEM

		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
77-47-4	6478	1,591	1,677	2,286	**5,554**	228	153	427	**808**	128	121	346	**595**
87-84-3	6907	23	60	257	**340**	5	32	30	**67**	3	21	21	**45**
1837-91-8	74603	7	94	235	**336**	2	31	43	**76**	1	17	23	**41**
3194-55-6	18529	122	1,261	3,796	**5,179**	73	291	1,000	**1,364**	59	194	626	**879**
3194-57-8	296646	17	45	26	**88**	3	7	15	**25**	1	5	10	**16**
3322-93-8	18728	9	136	708	**853**	4	62	102	**168**	3	31	47	**81**
25495-98-1	168375	93	520	1,451	**2,064**	12	130	509	**651**	3	70	224	**297**
25637-99-4	15724678	297	4,281	12,813	**17,391**	125	1,205	3,998	**5,328**	83	753	2,094	**2,930**
26657-83-0	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
30178-92-8	53432679	0	11	1	**12**	0	4	1	**5**	0	4	1	**5**
30554-73-5	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
31454-48-5	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
134237-50-6	11763618	0	6	31	**37**	0	0	3	**3**	0	0	3	**3**
134237-51-7	13040187	0	6	28	**34**	0	0	3	**3**	0	0	3	**3**
134237-52-8	11377211	23	278	1,985	**2,286**	7	116	765	**888**	4	69	387	**460**
138257-18-8	13040187	0	6	28	**34**	0	0	3	**3**	0	0	3	**3**
138257-19-9	73425481	0	0	2	**2**	0	0	0	**0**	0	0	0	**0**
169102-57-2	71350230	0	0	1	**1**	0	0	0	**0**	0	0	0	**0**
678970-15-5	11763618	0	6	31	**37**	0	0	3	**3**	0	0	3	**3**
678970-16-6	11479239	0	0	1	**1**	0	0	0	**0**	0	0	0	**0**
678970-17-7	11377211	23	278	1,985	**2,286**	7	116	765	**888**	4	69	387	**460**
1093632-34-8	33121	0	1	19	**20**	0	1	2	**3**	0	1	2	**3**

Source: PubChem Patent Data (See Exhibit 2-1 in main report and on OFR_universe_wPCPy_10122021.xlsx, tab 'Patent Info by CID' in Supplemental Information)

C.14 PHAS CITED IN LITERATURE REVIEW

A literature search was conducted to identify sources with information about chemicals in this OFR class (see Chapter 3). PHAs are mentioned or referenced in 32 of the 187 sources reviewed.



In this section, the following OECD use codes for chemicals are listed according to the internationally harmonized functional, product and article use categories:[5]

- AC5e. Fabrics, textiles, and apparel. Furniture & furnishings, including furniture coverings. Examples: Sofa cover, car seat cover, fabric chair, hammock.
- AC5f. Fabrics, textiles, and apparel. Other articles with routine direct contact during normal use. Examples: Shirts, pants, shorts, blankets, sheets.
- AC13a. Plastic articles (hard). Construction and building materials covering large surface areas. Examples: Outdoor play equipment, insulation (reacted off-site-, structural insulation panels), insulation applied on-site (spray polyurethane foam), flooring.
- AC13e. Plastic articles (hard). Furniture & furnishings, including furniture coverings. Examples: Computer casing.
- AC13g. Plastic articles (hard). Other articles made of plastic that are not expected to routinely be in contact with people. Examples:
- AC14e. Plastic articles (soft). Furniture & furnishings, including furniture coverings. Examples: Foam armchair, couch/sofa, mattress adult, mattress infant, mattress child, sleeping bag, beanbag chair.
- NA. Not applicable, could not be determined, or multiple products indicated. 0. Examples:

C.14.1 3194-55-6 1,2,5,6,9,10-HEXABROMOCYCLODODECANE

- This chemical was referenced in 22 sources
- Four sources mentioned product testing data and six reported concentration data:
    - EPS: between 1 and 2 percent
    - EPS: 0.3 to 0.7 percent
    - EPS boards: 0.5 percent
    - XPS boards: 0.5 to 1.0 percent
    - Mean concentration of HBCD in EPS, XPS, and extruded PS: 475,643 ng/g (0.47 percent)
    - EPS or XPS foam in rigid insulation panels/boards: added at <3 percent by weight
    - HIPS: 1 to 7 percent
    - Cotton material: 0.37 percent
    - Textile back coatings: 10 to 25 percent
    - Thermosol treatment of fabrics: applied as aqueous suspension or emulsion at loading of 8 to 11 percent by weight
    - Fabrics: loading factor of 3.4 mg per cm^2
- Nine sources cited use in consumer products (insulation boards, office equipment, compact florescent lights, LCD AV systems; floor mats; children's car seats; textile backing; upholstered furniture, packaging, electrical equipment).

[5] Source: OECD (2017). Note that OECD codes could not be assigned for all chemical uses cited in all literature sources. Some sources referenced multiple product types, some referenced product types that did not align closely with any of the OECD codes, and some referenced product types that were not specific enough (e.g., "infant car seats").

- Six sources reported human or environmental exposure data
- OECD use codes for this chemical include AC5e, AC5f, AC13a, AC13g, AC14e
- Three sources estimates global production in 2011 at 25,000 to 30,000 tonnes (high production volume).
- According to these sources, this chemical has been used as follows:
    - As a flame retardant in polystyrenes (EPS and XPS) (an estimated 85 percent of HBCD production is used as flame retardant in EPS and XPS foams, 5 percent in HIPS, and 10% in textile secondary backing coatings
    - Mixed with an acrylic or vinyl polymer that is applied to the back of the fabric
    - In polystyrene foams and resins, which are later used in upholstered furniture, vehicle interiors, blocks used in the construction of homes, roofs, packaging and electrical equipment.
    - In PS products, including EPS, XPS, and extruded plastic
    - In textiles and for the building industry
    - In EPS/XPS for building industry rigid insulation panels or boards
    - In HIPS for electronic and electrical equipment
    - As a textile coating agent, in polymer dispersions applied to upholstery fabrics, and for thermosol treatment of fabrics
    - Insulation boards (95 percent of HBCD use)
    - In HIPS in electronics, appliances, and possibly textiles for institutional, military, and aviation purposes
    - Not used in consumer textiles except for limited use in automotive textiles
    - In textiles, adhesives and coatings
- Four sources mentioned this chemical in the context of use trends over time, two addressed substitutes, 2 addressed end of life issues, and 5 mentioned laws or regulations.

C.14.2 3322-93-8 1,2-DIBROMO-4-(1,2-DIBROMOETHYL)CYCLOHEXANE

- This chemical was referenced in 8 sources
- Two sources mentioned product testing data, one included concentration data:
    - No detectable concentrations found in e-waste, vehicles, construction, or textiles.
- Two sources cited use in consumer products (curtains; fabric/vinyl; plastics in appliances)
- Two sources reported human or environmental exposure data
- OECD use codes for this chemical include: AC5e
- One source placed U.S. production in 2002 at between 4 and 225 metric tons (medium volume chemical).
- According to these sources, this chemical has been incorporated as additive into high-impact plastic parts of appliances, thermal insulation on houses, polystyrene foam, adhesives in fabric/vinyl, and electric cable coating.
- One source mentioned this chemical in the context of supply chain issues, one mentioned use trends over time, one addressed end of life issues, and one mentioned laws or regulations.

C.14.3 3194-57-8 1,2,5,6-TETRABROMOCYCLOOCTANE

- This chemical was referenced in 7 sources

- Two sources mentioned product testing data, one included concentration data:
    - No detectable concentrations found in e-waste, vehicles, construction, or textiles.
- One source cited use in consumer products (curtains)
- OECD use codes for this chemical include: AC5e
- No sources identified production volumes for this chemical
- According to a 2015 EPA source, no domestic uses were identified; the chemical is not functional in current EPS and XPS manufacturing processes
- One source mentioned this chemical in the context of use trends over time, one addressed end of life issues, and one mentioned laws or regulations.

C.14.4 25637-99-4 HEXABROMOCYCLODODECANE

- This chemical was referenced in 6 sources
- No sources mentioned product testing, but three sources referenced concentration data:
    - Flexible polyurethane foam: 0 to 15 percent
    - EPS boards: 0.5 percent
    - XPS boards: 0.5 to 1 percent
    - Textile back coatings: 10 to 25 percent
    - HIPS: 1 to 7 percent
- Three sources cited use in consumer products (inkjet printers, projectors, scanners; automotive floor mats; printed wiring boards) and one cited use in children's products (car seats)
- Two sources reported human or environmental exposure data
- OECD use codes for this chemical included AC5e, AC13a, AC14e
- One source cited 2001 global production of 16,7000 tonnes (high production volume). Another source indicates the United States imported 92,270 pounds in 2012.
- According to these sources, this chemical has been used in: XPS/EPS (insulation boards), HIPS (electronics, appliances), latex; PUF insulation board; paints and coatings; wallpaper; textiles/upholstery; printed wiring boards. Not used in consumer textiles except limited use in automotive textiles. Also used in automobile floor mats, roof interior coverings, and other interior fabrics of motor vehicles. In Europe it has been noted that EPS may be used in children's car seats or for insulation for transport vehicles.
- Three sources mentioned this chemical in the context of use trends over time, two addressed substitutes, two addressed end of life issues, and two mentioned laws or regulations.

C.14.5 87-84-3 PENTABROMOCHLOROCYCLOHEXANE

- This chemical was referenced in two sources
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- No specific uses for this chemical were identified in any of the sources reviewed
- One source mentioned this chemical in the context of use trends over time

C.14.6 134237-51-7 (+/-)-BETA-HEXABROMOCYCLODODECANE

- This chemical was referenced in four sources
- One source mentioned product testing data and included concentration data:
    - PS = 10-970 ng/g (< 0.0001 percent)
    - EPS= 23,000 ng/g (< 0.001 percent)
    - NSP= 60-690 ng/g (< 0.0001 percent)
    - ABS= 30 ng/g (< 0.00001 percent)
    - PO=450 ng/g (< 0.0001 percent)
- No sources cited use in consumer or children's products
- Two sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- One source indicated 2011 production of HBCD was 23,000 pounds (low production volume)
- No additional uses were identified from these sources
- One source mentioned laws or regulations

C.14.7 134237-52-8 (+/-)-GAMMA-HEXABROMOCYCLODODECANE

- This chemical was referenced in 5 sources
- One source mentioned product testing data and included concentration data:
    - PS = 70-550 ng/g (< 0.0001 percent)
    - ePS[6] = 250,000 ng/g (0.025 percent)
    - NSP = 70-440 ng/g (< 0.0001 percent)
    - PET = 150 ng/g (< 0.0001 percent)
    - Foil = 160 ng/g (< 0.0001 percent)
    - ABS = 100 ng/g (< 0.0001 percent)
    - PO = 470 ng/g (< 0.0001 percent)
- No sources cited use in consumer or children's products
- Two sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- One source indicated 2011 production of HBCD was 23,000 pounds (low production volume)
- No additional uses were identified from these sources
- Two sources mentioned this chemical in the context of laws or regulations.

C.14.8 25495-98-1 CYCLODECANE, HEXABROMO

- This chemical was referenced in two sources
- No sources mentioned product testing data or provided concentration data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- One source indicated EU production is between 1,000 and 10,000 pounds (high production volume)
- No additional uses were identified from these sources

[6] ePS = Expanded polystyrene

- No sources mentioned this chemical in the context of use trends over time, substitutes, end of life issues, or laws or regulations.

C.14.9 134237-50-6 (+/-)-?-HEXABROMOCYCLODODECANE

- This chemical was referenced in two sources
- One source mentioned product testing data, and included concentration data:
    - PP = 10-60 ng/g (< 0.00001 percent)
    - PS = 10 -3,600 ng/g (< 0.001 percent)
    - ePS = 52,000 ng/g (< 0.01 percent)
    - Foil = 10 ng/g (< 0.00001 percent)
    - NSP = 210-420ng/g (< 0.0001 percent)
    - PET = 830 ng/g (< 0.0001 percent)
    - HDPE = 80ng/g (< 0.00001 percent)
    - ABS = 20ng/g (< 0.00001 percent)
    - PO= 1,800 ng/g (< 0.001 percent)
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- One source estimated HBCD production at 23,000 pounds (low production volume)
- No additional uses were identified from these sources
- One source mentioned this chemical in the context of use trends over time, one mentioned substitutes, and one mentioned laws or regulations.

C.14.10 138257-19-9 (+)-ALPHA-HEXABROMOCYCLODODECANE

- This chemical was referenced in two sources
- No sources mentioned product testing data or provided concentration data
- No sources cited use in consumer or children's products
- One source reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided production volume estimates for this chemical
- No additional uses were identified from these sources
- One source mentioned this chemical in the context of laws or regulations.

C.14.11 1093632-34-8 1,3,5,7,9,11-HEXABROMOCYCLODODECANE

- This chemical was referenced in one source
- No sources mentioned product testing data or provided concentration data
- One source cited use in consumer products (building insulation)
- No sources reported human or environmental exposure data
- OECD use codes for this chemical include AC13e
- No sources provided production volume estimates for this chemical
- One source indicates the chemical is used in polystyrene foam for building insulation
- One source mentioned this chemical in the context of laws or regulations.

C.14.12 77-47-4 HEXACHLOROCYCLOPENTADIENE

- This chemical was referenced in two sources
- No sources mentioned product testing data or provided concentration data
- No sources cited use in consumer or children's products
- One source reported human or environmental exposure data
- OECD use codes for this chemical include AC13e
- One source indicated EU production is between over 1,500 tonnes (high production volume)
- No additional uses were identified in these sources
- No source mentioned this chemical in the context of supply chain issues, substitutes, end of life issues, or laws or regulations

C.14.13 31454-48-5 1,3,5,7-TETRABROMOCYCLOOCTANE

- This chemical was referenced in one source
- No sources mentioned product testing data or provided concentration data
- No sources cited use in consumer or children's products
- One source reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source indicated production volume information for this chemical
- No additional uses were identified in these sources
- No source mentioned this chemical in the context of supply chain issues, substitutes, end of life issues, or laws or regulations

C.15 LITERATURE SOURCES USED

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APPENDIX D | POLYHALOGENATED ALIPHATIC CARBOXYLATE CLASS SYNTHESIS

D.1 SUMMARY BY CHEMICAL – PHCX

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
All	**Across all 3 PHCXs**		**2**	**3**	**0**	**NA**	**3**	**3**	**NA**	**NA**	**1**
19660-16-3	2,3-Dibromopropyl acrylate	BRN 1762849	1	1		med	0.9598	804	66%	50%	
3066-70-4	2,3-Dibromopropylmethacrylate		0	1		med	0.938	801	62%	57%	
5445-17-0	Propanoic acid, 2-bromo-, methyl ester		1	1		med	0.5214	4,914	64%	75%	1

D.1.1 OVERVIEW

There are three substances in the OFR class "Polyhalogenated aliphatic carboxylates" (PHCX), with key attributes described in the Summary by Chemical table (For field definitions and color scheme, see Guide to Summary Tables, Appendix B.1). Two of these are active TSCA Inventory[7] substances. The remaining chemical is not on the TSCA Inventory but does appear on one other international inventory we reviewed.

During our literature search, we found no citations referencing any of the three PHCX chemicals. Patent data provided through PubChem references all 3 PHCX chemicals, with 5445-17-0 having reported applicability in patents pertaining to flame retardants, primarily as a reactive component.

D.1.2 INDUSTRY PRODUCTION AND USE

EPA chemical data reporting for 2016, 2012, 2006, and 1998 indicate there have been no (non-CBI) manufacturing or importing activities reported for PHCX chemicals in any of these years.

No PHCX chemicals are current reportable under the Toxics Release Inventory; thus, there is no information available on the quantities of waste managed.

D.1.3 USE IN CONSUMER AND CHILDREN'S PRODUCTS

The states of Washington and Oregon require industry to report on chemicals of concern in products intended for use by children that are sold in those states. The reporting tool used by Washington and Oregon is known as the High Priority Chemicals Data System (HPCDS). According to data available from the HPCDS, manufacturers have reported no use of potentially hazardous PHCXs in children's products.

D.2 PHCXS ON NATIONAL AND INTERNATIONAL INVENTORIES AND REGISTRIES

Chemicals in class: 3

- 2 active on TSCA Inventory (recently manufactured/imported in U.S.)[8]
- 0 inactive on TSCA Inventory (no longer manufactured/imported in U.S.)
- 1 not on TSCA Inventory (never manufactured/imported in U.S.)

[7] The Toxic Substances Control Act (TSCA) Inventory is a list of chemical substances manufactured in or imported to the United States at some time since June 2006. For more information see https://www.epa.gov/tsca-inventory/tsca-inventory-notification-active-inactive-rule.

[8] "Active" indicates that U.S. manufacturing or importing activity has been reported since June 2006.

PHCXS ON THE TSCA ACTIVE INVENTORY	
5445-17-0	Propanoic acid, 2-bromo-, methyl ester
19660-16-3	2-Propenoic acid, 2,3-dibromopropyl ester
PHCXS ON THE TSCA INACTIVE INVENTORY	
None	

OTHER PHCXS ON INTERNATIONAL REGISTRIES		
3066-70-4	2,3-Dibromopropylmethacrylate	Japan CSCL

D.3 U.S. MANUFACTURING AND IMPORTING ACTIVITY, 2015

NUMBER OF REPORTS BY ACTIVITY TYPE						
PHCXS	MANUFACTURE	IMPORT	BOTH MANUFACTURE AND IMPORT	NOT SPECIFIED	CBI	TOTAL
None						

Source: U.S. EPA, CDR (2016).

D.4 U.S. MANUFACTURING AND IMPORTING VOLUMES, 2015

REPORTED VOLUMES BY ACTIVITY TYPE					
PHCXS	MANUFACTURE	IMPORT	PRODUCTION VOLUME (MANUFACTURE + IMPORT)	USED	EXPORTED
None					

-- data CBI or otherwise not disclosed
Source: U.S. EPA, CDR (2016).

D.5 U.S. PRODUCTION VOLUME TRENDS, 2012-2015

PHCXS	PV 2015	PV 2014	PV 2013	PV 2012
None				

-- data CBI or otherwise not disclosed
PV = manufacturing plus importing
Source: U.S. EPA, CDR (2016).

D.6 TYPE OF PROCESSING OR USE REPORTS, 2015

NUMBER OF REPORTS								
PHCXS	Processing as a Reactant	Processing—Incorporation Into Article	Processing—Incorporation Into Formulation, Mixture, or Reaction Product	Processing—Repackaging	Use—Non-Incorporative Activities	CBI	NKRA	Grand Total
None								

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

D.7 INDUSTRIAL USE REPORTS, 2015

NUMBER OF REPORTS																								
PHCXS	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
None																								
USED AS FLAME RETARDANT																								
None																								

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

D.8 INDUSTRIAL FUNCTION REPORTS, 2015

NUMBER OF REPORTS															
PHCXS	Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Other	Paint Additives and Coating Additives Not Described by Other Categories	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	CBI	NKRA	Grand Total
None															

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

D.9 INDUSTRIAL SECTOR REPORTS, 2015

NUMBER OF REPORTS: POLYHALOGENATED ALIPHATIC CARBOXYLATES																									
PHCX	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
ALL INDUSTRIAL FUNCTIONS																									
None																									
USED AS FLAME RETARDANT																									
None																									

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

D.10 CONSUMER AND CHILDREN'S PRODUCT USE REPORTS, 2015

NUMBER OF REPORTS						
PHCXS	COMMERCIAL	CONSUMER	CONSUMER AND COMMERCIAL	NKRA	CBI	TOTAL
None						

NKRA = not known or reasonably ascertainable
All reports for 79-94-7 were for use in *electrical and electronic products*.
Source: U.S. EPA, CDR (2016).

PHCXS	CHILDREN'S PRODUCT USE	NKRA	OTHER USE	TOTAL
None				

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

D.11 TOXIC RELEASE INVENTORY REPORTS

TRI-REPORTABLE CHEMICALS	
None	

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TOTAL PRODUCTION-RELATED WASTE REPORTED:							
PHCXS		2015	2016	2017	2018	2019	GRAND TOTAL
None	No. of Reports						
	Pounds of waste managed						

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TRI Reports by Industry:

None

D.12 HIGH PRIORITY CHEMICALS DATA SYSTEM REPORTS

NUMBER OF REPORTS BY YEAR											
PHCXS		2012	2013	2014	2015	2016	2017	2018	2019	2020[1]	TOTAL
None	Total	None									
	FR										
	Conc>0.1%										

[1] Partial year reporting.
Source: Interstate Chemicals Clearinghouse (2021).

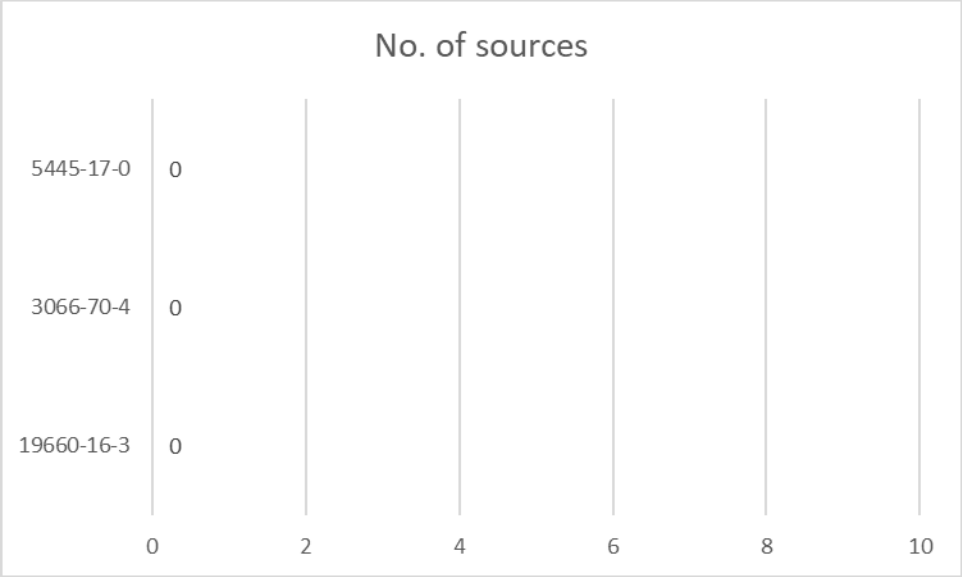
D.13 PATENT COUNTS FROM PUBCHEM

		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
3066-70-4	18297	51	256	494	**801**	9	13	29	**51**	7	7	13	**27**
5445-17-0	95576	358	1,423	3,133	**4,914**	0	1	3	**4**	0	0	1	**1**
19660-16-3	29728	63	212	529	**804**	8	2	10	**20**	6	2	2	**10**

Source: PubChem Patent Data (See Exhibit 2-1 in main report and on OFR_universe_wPCPy_10122021.xlsx, tab 'Patent Info by CID' in Supplemental Information)

D.14 PHCXS CITED IN LITERATURE REVIEW

A literature search was conducted to identify sources with information about chemicals in this OFR class (see Chapter 3). None of the three PHCXs are mentioned or referenced in the 187 sources reviewed.



D.14.1 19660-16-3

No information found in the literature reviewed.

D.14.2 3066-70-4

No information found in the literature reviewed.

D.14.3 5445-17-0

No information found in the literature reviewed.

D.15 LITERATURE SOURCES USED

No sources for chemicals in this OFR class.

APPENDIX E | POLYHALOGENATED ALIPHATIC CHAINS

E.1 SUMMARY BY CHEMICAL – PHACS

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
ALL	**Across all 47 PHACs**		**23**	**29**	**21**	**NA**	**18**	**14**	**NA**	**NA**	**20**
106232-85-3	Alkanes, C18-20, chloro		1	1	1	med		No CID			2
106232-86-4	Alkanes, C22-40, chloro		0	0		low		No CID			
108171-26-2	C10-12 chloroalkanes		1	1	2	med	0.9281	0			6
108171-27-3	Chloro C22-26 alkanes		0	1	1	low	0.9281	0			
109678-33-3	1-Propanol, 3,3'-oxybis[2,2-bis(bromomethyl)-		0	1		high	0.8168	16	81%	100%	
125512-87-0	Hexabromohexane		0	0		low	0.9528	No CID			
1372804-76-6	Alkanes, C14-16, chloro		1	0		low		No CID			2
1401974-24-0	Alkanes, C22-30-branched and linear, chloro		1	0		low		No CID			
1402738-52-6	Alkanes, C24-28, chloro		1	0		low		No CID			
1417900-96-9	Alkanes, C21-34-branched and linear, chloro		1	0		low		No CID			
1522-92-5	3-Bromo-2,2-bis(bromomethyl)propanol	BRN 1738921	0	1	2	high	0.8573	2,244	73%	70%	2
1852481-27-6	2,3,4,5,6,8-Hexachlorodecane	Chlorowax 500C	0	0		low	0.9321	18	0%	0%	
2097144-43-7	Alkanes, C20-28, chloro		1	0		low		No CID			
2097144-45-9	Alkanes, C20-24, chloro		1	0		low		No CID			
2097144-46-0	Hexacosane, chloro derivs.	BRN 1304582	1	0		low		No CID			
2097144-47-1	Octacosane, chloro derivs.		1	0		low		No CID			
2097144-48-2	Octadecane, chloro derivs.		1	0		low		No CID			
24173-07-7	1,2,3,4-Tetrabromo-2,3-dimethylbutane		0	0		low	0.8651	8	0%	0%	
288260-42-4	Alkanes, C22-30, chloro		1	0		low		No CID			
3234-02-4	2,3-Dibromo-2-butene-1,4-diol		0	1		high	0.1705	1,068	85%	45%	
3296-90-0	Pentaerythritol dibromide		3	1	5	high	0.8688	968	61%	37%	4

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
36483-57-5	Tribromoneopentyl alcohol	BRN 1738921	2	1	2	high	0.8573	No CID			
36678-45-2	2-Butene, 1,1,2,3,4,4-hexabromo-		0	1		low	0.4894	93	39%	38%	
61788-76-9	Chloroalkanes		2	1	1	med	0.9525	1	100%		3
63449-39-8	Chlorinated paraffins	multiple	2	1	2	high	0.6727	224	20%	0%	3
68527-01-5	Bromo chloro C12-30 a-alkenes		2	1		med		No CID			
68527-02-6	Alkenes, C12-24, chloro	BRN 1737429	2	1		med	0.8724	2	100%		
68920-70-7	Alkanes, C6-18, chloro		1	1	1	high		No CID			4
68955-41-9	1Bromo4chlorodecane		0	1	1	low	0.8747	1	100%		
71011-12-6	Alkanes, C12-13, chloro		0	2	1	high		No CID			2
75-95-6	Pentabromoethane		0	0		med	0.1226	574	44%	50%	
79-27-6	1,1,2,2-Tetrabromoethane	BRN 1098321; Acetylene tetrabomide; Muthmann's liquid	1	1		med	0.412	3,192	65%	53%	
84082-38-2	C10-21, chloro		0	1	1	med		No CID			3
84776-06-7	Alkanes, C10-32, chloro		0	1	1	med		No CID			1
84776-07-8	Alkanes, C16-27, chloro		0	0		low		No CID			
85049-26-9	Alkanes, C16-?35, chloro		0	1		low		No CID			
85422-92-0	Chlorinated paraffin oils		0	1	1	med		No CID			3
85535-84-8	C10-13 chloro alkanes		2.5	1	1	high		No CID			11
85535-85-9	Cercelor S 52 (MCCP)		2	1	4	high		No CID			4
85535-86-0	C18-28 Chloroalkanes		0	1	1	med		No CID			2
85536-22-7	Alkanes, C12-?14, chloro		0	1	1	med		No CID			2
85681-73-8	Chloroalkanes, C10-?14		0	1	1	med		No CID			2
96-13-9	2,3-Dibromopropanol	BRN 1719127; Brominex 257	1	1		high	0.8975	3,966	49%	40%	2

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
97553-43-0	Paraffins (petroleum), normal C>10, chloro		0	1	1	med		No CID			1
97659-46-6	Alkanes, C10-26, chloro		0	1	1	med		No CID			1
NOCAS_872-42-2	Long-chain chlorinated paraffins (C18-20)		0	0		med		No CID			
NOCAS_872-42-3	Medium-chain chlorinated paraffins (C14-17)		0	0		med		No CID			

E.1.1 OVERVIEW

There are 47 substances in the OFR class "Polyhalogenated aliphatic chains" (PHACs), with key attributes described in the Summary by Chemical table (For field definitions and color scheme, see Guide to Summary Tables, Appendix B.1). Of these, 39 are reported on one or more chemical inventories we reviewed. This includes 21 that are active TSCA Inventory[9] substances and another three that are inactive. Eleven active and one inactive TSCA Inventory substances appear on other (non-U.S.) inventories. An additional 15 substances not on the TSCA Inventory appear on non-U.S. inventories, including those of the EU, Canada, Mexico, Japan, and China. The remaining eight substances do not appear on any inventories we reviewed.

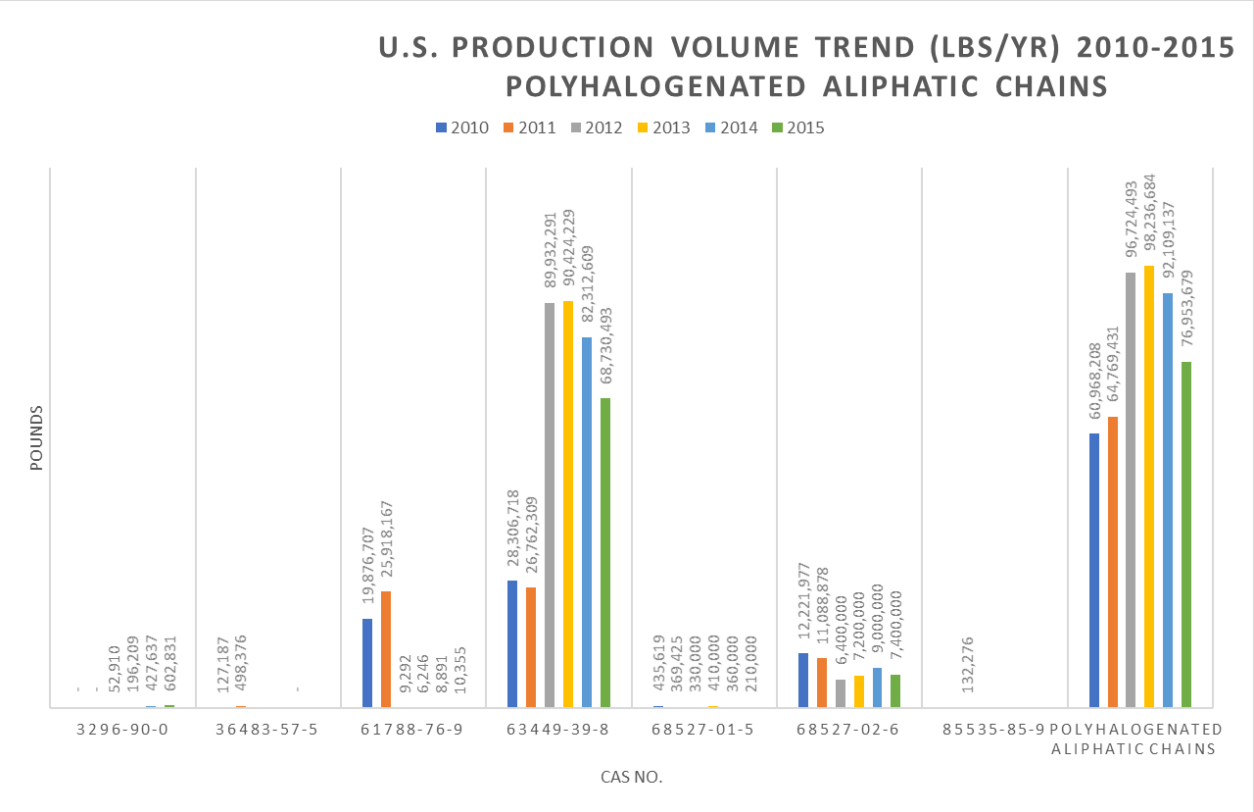
During our literature search, we found that while some of the PHAC chemicals found on the TSCA inventory are referenced in the literature, others are not. In our literature search, we were able to collect data for seven TSCA active chemicals, two TSCA inactive chemicals, and 12 PHAC chemicals identified in other inventories. Patent data provided through PubChem reported information on only 14 PHAC chemicals. The low percentage is because many PHAC CAS numbers were not associated with specific CIDs, the PubChem primary identifier.

E.1.2 INDUSTRY PRODUCTION AND USE

Most of the available information from EPA focuses on nine of the 47 PHAC chemicals, which are all active TSCA Inventory substances. A single substance, chlorinated paraffins (CAS No. 63449-39-8), accounted for close to 90 percent of the reported PHAC production (manufacturing or importing) activity in the United States in 2015.

For the most recent year available from EPA, 2015, U.S. industry reported manufacturing and importing PHACs into the United States. Specifically, industry submitted six reports of manufacturing activity (CAS Nos. 63449-39-8 [2 reports], 68527-02-6 [2 reports], 68527-01-5 [1 report] and 36483-57-5 [1 report], 12 reports of importing activity (CAS Nos. 63449-39-8 [8 reports], 61788-76-9 [2 reports], and 3296-90-0 [2 report]), and seven additional reports where the activity was not specified or was claimed as CBI. Twelve of the 25 reports received in 2015 were for chlorinated paraffins (CAS No. 63449-39-8).

[9] The Toxic Substances Control Act (TSCA) Inventory is a list of chemical substances manufactured in or imported to the United States at some time since June 2006. For more information see https://www.epa.gov/tsca-inventory/tsca-inventory-notification-active-inactive-rule.



Source: U.S. EPA, CDR (2011-2016).

In the literature, CAS No. 85535-85-9 has been cited as a high production volume chemical, while CAS No. 3296-90-0 has been cited as a medium production volume chemical, and CAS No. 85535-84-8 has been cited as a low production volume chemical. Historical data from EPA indicates CAS No. 61788-76-9 has previously been produced at high volumes as well.

Total reported production volume (manufacturing plus importing) in 2015 included 68.7 million pounds for CAS No. 63449-39-8, 7.4 million pounds for CAS No. 68527-02-6, 602,000 pounds for CAS No. 3296-90-0, 210,000 pounds for CAS No. 68527-01-5, and 10,000 pounds for CAS No. 61788-76-9. Production volume (PV) trend data for 2010-2015 indicates the combined PV for reported PHACs averaged 81.6 million pounds per year.

Data from EPA indicate that the PV of PHAC chemicals increased from 60.9 million pounds in 2010 to 96.7 million pounds in 2012 but has since decreased to 76.9 million pounds in 2015. Nevertheless, these chemicals have been produced in very large quantities, each year, for over a decade.

Industry identified 54 processing and use activities for PHAC substances in 2015, of which 33 involved processing or use as a flame retardant. From industry reporting to EPA, uses as a flame retardant included:

- Plastics product manufacturing (7 reports)
- Paint and coating manufacturing (5 reports)
- Rubber product manufacturing (5 reports)

- Adhesive manufacturing (4 reports)
- All other chemical product and preparation manufacturing (4 reports)
- Textiles, apparel, and leather manufacturing (4 reports)
- Plastic material and resin manufacturing (2 reports)
- Furniture and related product manufacturing (1 report)
- Synthetic rubber manufacturing (1 report)

Over the period 2015-2019, industry has submitted between four and nine reports each year under the Toxics Release Inventory (TRI) for CAS No. 85535-84-8 and two to three reports each year for CAS No. 3296-90-0.

Industries accounting for the most TRI reports for CAS No. 85535-84-8 included:

- Motor Vehicle Gasoline Engine and Engine Parts Manufacturing
- Solid Waste Combustors and Incinerators
- Motor Vehicle Transmission and Power Train Parts Manufacturing

Reported use classifications for CAS No. 3296-90-0 included:

- 3.2A: P102. Processing as a reactant (Raw materials)
- 3.2B: P210. Processing as a formulation component (Flame retardants)
- 3.3B: Z201. Otherwise use as a manufacturing aid (Process lubricants)
- 3.3B: Z202. Otherwise use as a manufacturing aid (Metalworking fluids)
- 3.3C: Z303. Otherwise use: ancillary or other use (Lubricant)
- 3.3C: Z304. Otherwise use: ancillary or other use (Fuel)
- 3.3C: Z306. Otherwise use: ancillary or other use (Waste treatment)

TRI reports indicate the waste volume managed for CAS No. 85535-84-8 fluctuated between 56,000 and 214,000 pounds per year for 2016 to 2019. Most of these reports were from the motor vehicle manufacturing sector with a smaller number from the solid waste disposal, cement manufacturing, and adhesive manufacturing industries. Waste volumes managed for CAS No. 3296-90-0 were much smaller, averaging 1,400 pounds per year from 2016 to 2019. All reports were from the plastics manufacturing and urethane manufacturing industries.

E.1.3 USE IN CONSUMER AND CHILDREN'S PRODUCTS

Under the CDR, industry submitted one report for 63449-39-8 (Chlorinated paraffins) and one report for CAS No. 36483-57-5 (Tribromoneopentyl alcohol) identifying a consumer use. Industry also submitted two CDR reports each for CAS Nos. 1401974-24-0 and 1402738-52-6 indicating the consumer use was CBI. Product testing data found in the literature search also indicate consumer uses, specifically in flexible PVC. Gaps in information within the supply chain, however, may make it difficult for industry to know or reasonably ascertain if hazardous chemicals are or will be used in consumer or children's products.

The states of Washington and Oregon require industry to report on chemicals of concern in products intended for use by children that are sold in those states. The reporting tool used by Washington and Oregon is known as the High Priority Chemicals Data System (HPCDS). According to data available from the HPCDS, manufacturers have reported the use of potentially hazardous PHACs in children's products.

During the most recent complete reporting year, 2019, Alkanes, C10-13, chloro (CAS No. 85535-84-8) was one of the most reported OFR chemicals of concern in children's products, to the HPCDS, receiving 83 reports of use.

Over the period 2012-2020, 206 reports were submitted for PHACs (163 reports for CAS No. 85535-84-8 and 43 reports for CAS No, 108171-26-2). Of these, 10 reports indicated the chemical function in each product was "flame retardant" and four of these (all in 2020) reported the concentration in the final product exceeded 0.1 percent: two reports each for alkanes, C10-13 chloro (CAS No. 85535-84-8) and chlorinated paraffins (CAS No. 108171-26-2). All four reports listed the children's product category as dolls/soft toys (non-powered).

Both alkanes, C10-13 chloro (CAS No. 85535-84-8) and chlorinated paraffins (CAS No. 108171-26-2) were reported by industry to be used as a flame retardant in concentrations greater than 0.1 percent, in the following components of non-powered dolls/soft toys:

- Synthetic polymers (synthetic rubber, plastics, foams, etc.); and
- Textiles (synthetic fibers and blends).

According to the HPCDS, CAS No. 85535-84-8 is found in children's products in concentrations equal to or greater than 10,000 ppm when it is used as an adhesive or in serving no (chemical) function. As an adhesive, it is reported to be in homogenous mixtures used in children's sleepwear variety packs and children's clothing variety packs. It can be found in concentrations greater than 10,000 ppm with no chemical function, in the surface coatings of non-powered dolls and soft toys, the synthetic polymers of powered toy vehicles, and the textiles of dolls and soft toys, and toy/game variety packs. CAS No. 108171-26-2 is also reported to be used in children's products in concentrations equal to or greater than 10,000 ppm in the textiles of toy/game variety packs, with no intended chemical function.

PHACs have been cited in 10 of the 187 literature sources reviewed. Among the seven PHACs cited, chemicals appearing in the greatest number of these sources include: CAS Nos. 3296-90-0 (5 sources), 85535-85-9 (4 sources) and 63449-29-8, 1522-92-5, 36483-57-5, and 108171-26-2 (2 sources each). No sources reported concentration data for any products in this class.

Uses for PHACs identified through the literature review (as described in Chapter 3) include:

CAS No. 108171-26-2: polyvinyl chloride (PVC) plasticizers, paints, adhesives and sealants, leather fat liquors, and rubber/flame retardants/textiles/polymers (other than PVC).

CAS No. 3296-90-0: rigid polyurethane foams and unsaturated polyester resins for molded products; polymers and thermoplastic manufacturing; building and construction materials.

CAS No. 36483-57-5: rigid and flexible foams; thermoplastic resins, thermoset resins, textiles, adhesives, circuit boards, electronic enclosures, paper, thermal insulation for building applications.

CAS No. 63449-39-8: plasticizers, additives in rubbers, plastics, paints, coatings, sealants, and adhesives.

CAS No. 71011-12-6: PVC plasticizers, paints, adhesives and sealants, leather fat liquors, and rubber/flame retardants/textiles/polymers (other than PVC).

CAS No. 85535-85-9: PVC plasticizers, paints, adhesives and sealants, leather fat liquors, and rubber/flame retardants/textiles/polymers (other than PVC).

CAS No. 85536-22-7: PVC plasticizers, paints, adhesives and sealants, leather fat liquors, and rubber/flame retardants/textiles/polymers (other than PVC).

CAS No. 85681-73-8: PVC plasticizers, paints, adhesives and sealants, leather fat liquors, and rubber/flame retardants/textiles/polymers (other than PVC).

E.2 PHACS ON NATIONAL AND INTERNATIONAL INVENTORIES AND REGISTRIES

Chemicals in class: 47

- 21 active on TSCA Inventory (recently manufactured/imported in U.S.)[10]
- 3 inactive on TSCA Inventory (no longer manufactured/imported in U.S.)
- 23 not on TSCA Inventory (never manufactured/imported in U.S.)

PHACS ON THE TSCA ACTIVE INVENTORY	
79-27-6	1,1,2,2-Tetrabromoethane
96-13-9	2,3-Dibromopropanol
3296-90-0	Pentaerythritol dibromide
36483-57-5	Tribromoneopentyl alcohol
61788-76-9	Chloroalkanes
63449-39-8	Chlorinated paraffins
68527-01-5	Bromo chloro C12-30 a-alkenes
68527-02-6	Alkenes, C12-24, chloro
68920-70-7	Alkanes, C6-18, chloro
85535-85-9	Cercelor S 52 (MCCP)
106232-85-3	Alkanes, C18-20, chloro
288260-42-4	Alkanes, C22-30, chloro
1372804-76-6	Alkanes, C14-16, chloro
1401974-24-0	Alkanes, C22-30-branched and linear, chloro
1402738-52-6	Alkanes, C24-28, chloro
1417900-96-9	Alkanes, C21-34-branched and linear, chloro
2097144-43-7	Alkanes, C20-28, chloro
2097144-45-9	Alkanes, C20-24, chloro
2097144-46-0	Hexacosane, chloro derivs.
2097144-47-1	Octacosane, chloro derivs.
2097144-48-2	Octadecane, chloro derivs.
PHACS ON THE TSCA INACTIVE INVENTORY	
36678-45-2	2-Butene, 1,1,2,3,4,4-hexabromo-
68955-41-9	1-Bromo-4-chlorodecane
71011-12-6	Alkanes, C12-13, chloro

Source: U.S. EPA, CDR (2016).

[10] "Active" indicates that U.S. manufacturing or importing activity has been reported since June 2006.

OTHER PHACS ON INTERNATIONAL REGISTRIES		
3234-02-4	2,3-Dibromo-2-butene-1,4-diol	Canada DSL, EU Reach, Mexico INSQ, China IECSC
84082-38-2	C10-21, chloro	Canada DSL, China IECSC, Japan CSCL
85422-92-0	Chlorinated paraffin oils	Canada DSL, Japan CSCL
85535-84-8	C10-13 chloro alkanes	Canada DSL, EU Reach, Mexico INSQ, China IECSC, Japan CSCL
85535-86-0	C18-28 Chloroalkanes	Canada DSL
109678-33-3	1-Propanol, 3,3'-oxybis[2,2-bis(bromomethyl)-	EU Reach
108171-26-2	C10-12 chloroalkanes	Japan CSCL
1522-92-5	3-Bromo-2,2-bis(bromomethyl)propanol	Japan CSCL, China - IECSC
71011-12-6	Alkanes, C12-13, chloro	Japan CSCL
84776-06-7	Alkanes, C10-32, chloro	Japan CSCL
85049-26-9	Alkanes, C16-35, chloro	Japan CSCL
85536-22-7	Alkanes, C12-14, chloro	Japan CSCL
85681-73-8	Chloroalkanes, C10-14	Japan CSCL
97553-43-0	Paraffins (petroleum), normal C>10, chloro	Japan CSCL
97659-46-6	Alkanes, C10-26, chloro	Japan CSCL
108171-27-3	Chloro C22-26 alkanes	China IECSC

Source: U.S. EPA, CDR (2016).

E.3 U.S. MANUFACTURING AND IMPORTING ACTIVITY, 2015

NUMBER OF REPORTS BY ACTIVITY TYPE						
PHACS	MANUFACTURE	IMPORT	BOTH MANUFACTURE AND IMPORT	NOT SPECIFIED	CBI	TOTAL
1401974-24-0					1	1
1402738-52-6					1	1
1417900-96-9					1	1
3296-90-0		2			1	3
36483-57-5	1				1	2
61788-76-9		2				2
63449-39-8	2	8		2		12
68527-01-5	1					1
68527-02-6	2					2
Totals	**6**	**12**		**2**	**5**	**25**

Source: U.S. EPA, CDR (2016).

E.4 U.S. MANUFACTURING AND IMPORTING VOLUMES, 2015

REPORTED VOLUMES BY ACTIVITY TYPE					
PHACS	MANUFACTURE	IMPORT	PRODUCTION VOLUME (MANUFACTURE + IMPORT)	USED	EXPORTED
1401974-24-0	-	-	-	-	-
1402738-52-6	-	-	-	-	-
1417900-96-9	-	-	-	-	-
3296-90-0	-	602,831	602,831	-	54,233
36483-57-5	-	-	-	-	-
61788-76-9	-	10,355	10,355	10,355	-
63449-39-8	68,000,000	730,493	68,730,493	35,300	2,167,512
68527-01-5	210,000	-	210,000	-	-
68527-02-6	7,400,000	-	7,400,000	-	156,000
Totals	**75,610,000**	**1,343,679**	**76,953,679**	**45,655**	**2,377,745**

-- data CBI or otherwise not disclosed
Source: U.S. EPA, CDR (2016).

E.5 U.S. PRODUCTION VOLUME TRENDS, 2012-2015

PHACS	PV 2015	PV 2014	PV 2013	PV 2012
1401974-24-0	-	-	-	-
1402738-52-6	-	-	-	-
1417900-96-9	-	-	-	-
3296-90-0	602,831	427,637	196,209	52,910
36483-57-5	-	-	-	-
61788-76-9	10,355	8,891	6,246	9,292
63449-39-8	68,730,493	82,312,609	90,424,229	89,932,291
68527-01-5	210,000	360,000	410,000	330,000
68527-02-6	7,400,000	9,000,000	7,200,000	6,400,000
Total	**76,953,679**	**92,109,137**	**98,236,684**	**96,724,493**

-- data CBI or otherwise not disclosed
PV = manufacturing plus importing
Source: U.S. EPA, CDR (2016).

E.6 TYPE OF PROCESSING OR USE REPORTS, 2015

NUMBER OF REPORTS								
PHACS	Processing as a Reactant	Processing—Incorporation Into Article	Processing—Incorporation Into Formulation, Mixture, or Reaction Product	Processing—Repackaging	Use—Non-Incorporative Activities	CBI	NKRA	Grand Total
1401974-24-0						2		2
1402738-52-6						2		2
1417900-96-9						4		4
3296-90-0			3					3
36483-57-5			2					2
61788-76-9	1	1						2
63449-39-8			22	1			1	24
68527-01-5			1					1
68527-02-6			14					14
Totals	**1**	**1**	**42**	**1**		**8**	**1**	**54**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

E.7 INDUSTRIAL USE REPORTS, 2015

NUMBER OF REPORTS																							
PHACS	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
1401974-24-0																						2		2
1402738-52-6																						2		2
1417900-96-9																						4		4
3296-90-0													1			1	1							3
36483-57-5										1							1							2
61788-76-9			1						1															2
63449-39-8	2			2									5		4	2	2	3	1	2			1	24
68527-01-5																	1							1
68527-02-6	2			2									2		2		2	2		2				14
Totals	**4**		**1**	**4**					**1**	**1**			**8**		**6**	**3**	**7**	**5**	**1**	**4**		**8**	**1**	**54**

NUMBER OF REPORTS																								
PHACS	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
USED AS FLAME RETARDANT																								
3296-90-0																1	1							
36483-57-5										1							1							
63449-39-8	2			2									3			1	2	3	1	2				
68527-01-5																	1							
68527-02-6	2			2									2				2	2		2				
Totals	**4**			**4**						**1**			**5**			**2**	**7**	**5**	**1**	**4**				**33**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

E.8 INDUSTRIAL FUNCTION REPORTS, 2015

NUMBER OF REPORTS									
PHACS	Flame Retardants	Intermediates	Lubricants and Lubricant Additives	Paint Additives and Coating Additives Not Described by Other Categories	Plasticizers	Processing Aids, Specific to Petroleum Production	CBI	NKRA	Grand Total
1401974-24-0							2		2
1402738-52-6							2		2
1417900-96-9							4		4
3296-90-0	2					1			3
36483-57-5	2								2
61788-76-9		1	1						2
63449-39-8	16		4	2	1			1	24
68527-01-5	1								1
68527-02-6	12		2						14
Grand Total	**33**	**1**	**7**	**2**	**1**	**1**	**8**	**1**	**54**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

E.9 INDUSTRIAL SECTOR REPORTS, 2015

NUMBER OF REPORTS: POLYHALOGENATED ALIPHATIC CHAINS																								
PHAC	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, And Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
ALL INDUSTRIAL FUNCTIONS																								
Total	4		1	4					1	1			8		6	3	7	5	1	4		8	1	54
1401974-24-0																						2		2
1402738-52-6																						2		2
1417900-96-9																						4		4
3296-90-0													1			1	1							3
36483-57-5										1							1							2
61788-76-9			1						1															2
63449-39-8	2			2									5		4	2	2	3	1	2			1	24
68527-01-5																	1							1
68527-02-6	2			2									2		2		2	2		2				14

NUMBER OF REPORTS: POLYHALOGENATED ALIPHATIC CHAINS																							
PHAC	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, And Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
USED AS FLAME RETARDANT																							
Total	4			4						1			5			2	7	5	1	4				33
3296-90-0																1	1							2
36483-57-5										1							1							2
63449-39-8	2			2									3			1	2	3	1	2				16
68527-01-5																	1							1
68527-02-6	2			2									2				2	2		2				12

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

E.10 CONSUMER AND CHILDREN'S PRODUCT USE REPORTS, 2015

NUMBER OF REPORTS						
PHACS	COMMERCIAL	CONSUMER	CONSUMER AND COMMERCIAL	NKRA	CBI	TOTAL
1401974-24-0					2	2
1402738-52-6					2	2
1417900-96-9				5		5
3296-90-0	3					3
36483-57-5	1		1			2
61788-76-9	1					1
63449-39-8	4		1	1		6
Totals	**9**		**2**	**6**	**4**	**21**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

The report for 36483-57-5 under the "Consumer and commercial" column was for use in f*oam seating and bedding products.* The report for 63449-39-8 was for use in *plastic and rubber products not covered elsewhere.*

PHACS	CHILDREN'S PRODUCT USE	NKRA	OTHER USE	TOTAL
1401974-24-0		2		2
1402738-52-6		1	1	2
1417900-96-9		4	1	5
3296-90-0			3	3
36483-57-5		1	1	2
61788-76-9			1	1
63449-39-8		1	5	6
Totals		**9**	**12**	**21**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

E.11 TOXIC RELEASE INVENTORY REPORTS

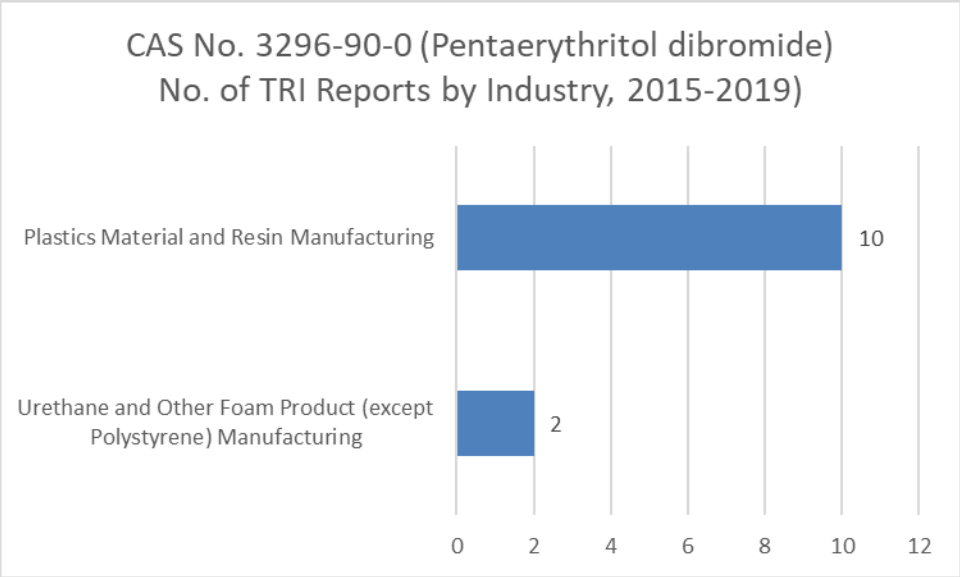
TRI-REPORTABLE CHEMICALS	
3296-90-0	Pentaerythritol dibromide
85535-84-8	C10-13 chloro alkanes

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

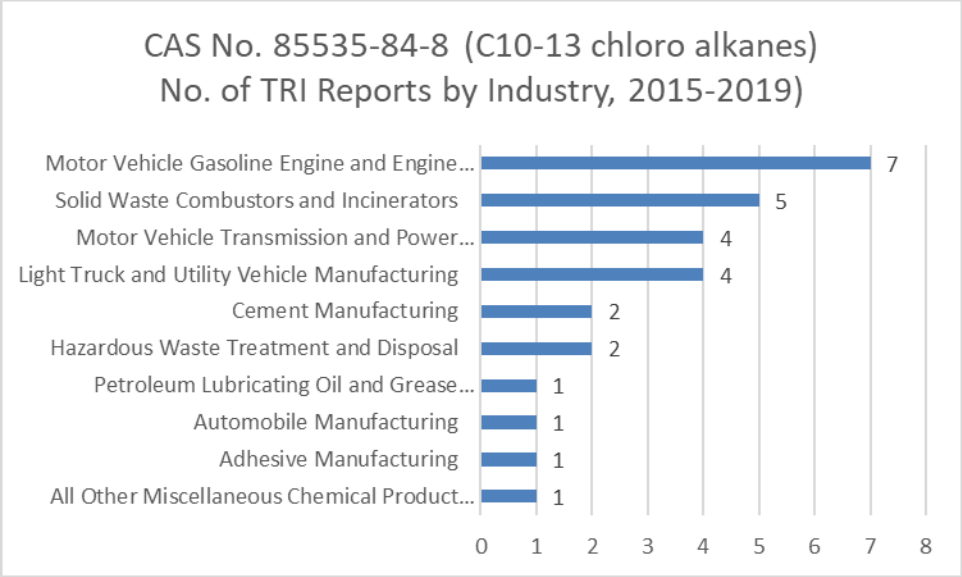
TOTAL PRODUCTION-RELATED WASTE REPORTED							
PHACS		2015	2016	2017	2018	2019	GRAND TOTAL
3296-90-0	No. of Reports	2	2	2	3	3	12
	Pounds of waste managed	94	875	2,428	1,294	1,121	5,811.52
85535-84-8	No. of Reports	7	4	2	9	6	28
	Pounds of waste managed	213,979	156,953	56,374	171,530	68,255	667,091.38
Total	**No. of Reports**	**9**	**6**	**4**	**12**	**9**	**40**
	Pounds of waste managed	**214,073**	**157,828**	**58,802**	**172,824**	**69,376**	**672,902.90**

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TRI REPORTS BY INDUSTRY



Source: U.S. EPA, Toxics Release Inventory (2015-2019).



Source: U.S. EPA, Toxics Release Inventory (2015-2019).

E.12 HIGH PRIORITY CHEMICALS DATA SYSTEM REPORTS

NUMBER OF REPORTS BY YEAR											
PHACS		2012	2013	2014	2015	2016	2017	2018	2019	2020[1]	TOTAL
108171-26-2	Total						2	9	22	10	41
	FR						1		2	3	6
	Conc>0.1%									2	2
85535-84-8	Total						3	41	83	36	163
	FR						1			3	4
	Conc>0.1%									2	2

[1] Partial year reporting.
Reported uses at >0.1 percent included *dolls/soft toys*.
Source: Interstate Chemicals Clearinghouse (2021).

E.13 PATENT COUNTS FROM PUBCHEM

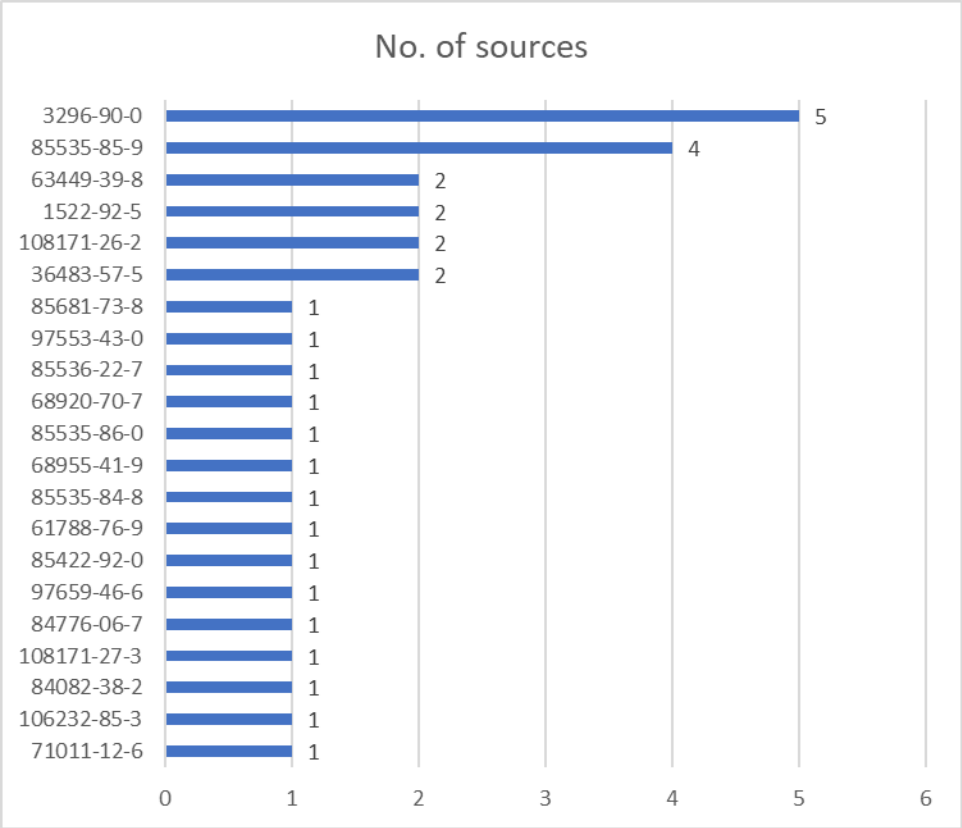
		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
75-95-6	60967	177	143	254	**574**	2	0	2	**4**	0	0	0	**0**
79-27-6	6588	369	759	2,064	**3,192**	31	48	89	**168**	22	35	20	**77**
96-13-9	7281	432	1,578	1,956	**3,966**	169	118	189	**476**	55	81	109	**245**
1522-92-5	15206	162	444	1,638	**2,244**	87	148	546	**781**	40	96	269	**405**
3234-02-4	641240	59	103	906	**1,068**	21	6	22	**49**	11	3	18	**32**
3296-90-0	18692	144	230	594	**968**	83	23	61	**167**	41	17	45	**103**
24173-07-7	14709185	0	8	0	**8**	0	1	0	**1**	0	0	0	**0**
36483-57-5	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
36678-45-2	3032934	26	31	36	**93**	3	23	16	**42**	2	15	1	**18**
61788-76-9	22833341	0	0	1	**1**	0	0	0	**0**	0	0	0	**0**
63449-39-8	6537497	71	108	45	**224**	6	5	0	**11**	6	3	0	**9**
68527-01-5	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
68527-02-6	6437560	0	0	2	**2**	0	0	0	**0**	0	0	0	**0**
68920-70-7	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
68955-41-9	13791119	0	0	1	**1**	0	0	0	**0**	0	0	0	**0**
71011-12-6	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
84082-38-2	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
84776-06-7	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
84776-07-8	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
85049-26-9	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
85422-92-0	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
85535-84-8	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
85535-85-9	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
85535-86-0	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
85536-22-7	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
85681-73-8	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**

		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
97553-43-0	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
97659-46-6	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
106232-85-3	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
106232-86-4	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
108171-26-2	22833489	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
108171-27-3	22833490	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
109678-33-3	15708903	0	3	13	**16**	0	0	9	**9**	0	0	9	**9**
125512-87-0	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
288260-42-4	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
1372804-76-6	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
1401974-24-0	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
1402738-52-6	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
1417900-96-9	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
1852481-27-6	6537498	12	6	0	**18**	6	4	0	**10**	6	1	0	**7**
2097144-43-7	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
2097144-45-9	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
2097144-46-0	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
2097144-47-1	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
2097144-48-2	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
NOCAS_872-42-2	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
NOCAS_872-42-3	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**

Source: PubChem Patent Data (See Exhibit 2-1 in main report and on OFR_universe_wPCPy_10122021.xlsx, tab 'Patent Info by CID' in Supplemental Information)

E.14 PHACS CITED IN LITERATURE REVIEW

A literature search was conducted to identify sources with information about chemicals in this OFR class (see Chapter 3). PHACs are mentioned or referenced in 10 of the 187 sources reviewed.



E.14.1 3296-90-0 PENTAERYTHRITOL DIBROMIDE

- This chemical was referenced in five sources
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer products
- According to one source, this chemical is used to make UPE-Unsaturated polyester resins
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- Three sources cited production between 100 and 1,000 tonnes annually (medium to high production volume)
- According to these sources, this chemical is use in rigid polyurethan foams and unsaturated polyester resins for molded products, rigid foams, polymers and for thermoplastic manufacturing as well as in building and construction work
- One source mentioned this chemical in the context of use trends over time

E.14.2 85535-85-9 CERCELOR S 52 (MCCP)

- This chemical was referenced in four sources
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer products
- According to one source, this chemical is used to make PVC – flex (flexible polyvinyl chloride)
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- One source cited the production volume of this chemical to be 10,000 to 100,000 tonnes annually (high production volume)
- According to these sources, this chemical is used in cable, wire, and jacketing

E.14.3 63449-39-8 CHLORINATED PARAFFINS

- This chemical was referenced in two sources
- No sources mentioned product testing data, or provided concentration data
- One source cited use in consumer products (paints, coatings, sealants, adhesives)
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- According to these sources, this chemical is used in plasticizers, additives in rubbers, plastics, paints, coatings, sealants, and adhesives
- One source mentioned this chemical in the context of laws or regulations

E.14.4 1522-92-5 3-BROMO-2,2-BIS(BROMOMETHYL)PROPANOL

- This chemical was referenced in two sources
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer products
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- No additional uses were identified from these sources

E.14.5 108171-26-2 C10-12 CHLOROALKANES

- This chemical was referenced in two sources
- No sources mentioned product testing data, or provided concentration data
- One source cited use in consumer products (paints, adhesives and sealants)
- According to one source, this chemical is used to make PVC-flex (flexible polyvinyl chloride)
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- According to one source, this chemical is used in PVC plasticizers, paints, adhesives and sealants, leather fat liquors, and rubber/flame retardants/textiles/polymers (other than PVC)
- One source mentioned this chemical in the context of use trends over time
- One source mentioned this chemical in the context of laws or regulations

E.14.6 36483-57-5 TRIBROMONEOPENTYL ALCOHOL

- This chemical was referenced in two sources
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer products
- According to two sources, this chemical is used to make PS and PU
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- According to these sources, this chemical is used to make thermoplastic resins, thermoset resins, textiles, adhesives, circuit boards, electronic enclosures, paper, thermal insulation for building applications, and rigid and flexible foams

E.14.7 106232-85-3 ALKANES, C18-20, CHLORO

- This chemical was referenced in one source
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer products
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- No additional uses were identified from these sources

E.14.8 108171-27-3 CHLORO C22-26 ALKANES

- This chemical was referenced in one source
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer products
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- No additional uses were identified from these sources

E.14.9 61788-76-9 CHLOROALKANES

- This chemical was referenced in one source
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer products
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- No additional uses were identified from these sources

E.14.10 68920-70-7 ALKANES, C6-18, CHLORO

- This chemical was referenced in one source
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer products

- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- One source mentioned this chemical in the context of laws or regulations
- No additional uses were identified from these sources

E.14.11 68955-41-9 1-BROMO-4-CHLORODECANE

- This chemical was referenced in one source
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer products
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- No additional uses were identified from these sources

E.14.12 71011-12-6 ALKANES, C12-13, CHLORO

- This chemical was referenced in one source
- No sources mentioned product testing data, or provided concentration data
- One source cited use in consumer products (paints, adhesives, sealants)
- According to one source, this chemical is used to make PVC - flex-Flexible polyvinyl chloride
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- One source mentioned this chemical in the context of laws or regulations

E.14.13 84082-38-2 C10-21, CHLORO

- This chemical was referenced in one source
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer products
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- No additional uses were identified from these sources

E.14.14 84776-06-7 ALKANES, C10-32, CHLORO

- This chemical was referenced in one source
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer products
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- No additional uses were identified from these sources

E.14.15 85422-92-0 CHLORINATED PARAFFIN OILS

- This chemical was referenced in one source
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer products
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- No additional uses were identified from these sources

E.14.16 85535-84-8 C10-13 CHLORO ALKANES

- This chemical was referenced in one source
- No sources mentioned product testing data, or provided concentration data
- One source cited use in consumer products (paints, adhesives, sealants)
- According to one source, this chemical is used to make PVC – flex (flexible polyvinyl chloride)
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- One source cited EU production to be 1,500 to 2,500 tonnes in 2006, while the U.S. production was 8,000 tonnes (high production volume)
- According to these sources, this chemical is used in PVC plasticizers, paints, adhesives and sealants, leather fat liquors, and rubber/flame retardants/textiles/polymers (other than PVC)
- One source mentioned this chemical in the context of laws or regulations

E.14.17 85535-86-0 C18-28 CHLOROALKANES

- This chemical was referenced in one source
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer products
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- No additional uses were identified from these sources

E.14.18 85536-22-7 ALKANES, C12-?14, CHLORO

- This chemical was referenced in one source
- No sources mentioned product testing data, or provided concentration data
- One source cited use in consumer products (paints, adhesives, sealants)
- According to one source, this chemical is used to make PVC - flex-Flexible polyvinyl chloride
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- According to these sources, this chemical is used in PVC plasticizers, paints, adhesives and sealants, leather fat liquors, and rubber/flame retardants/textiles/polymers (other than PVC)
- One source mentioned this chemical in the context of laws or regulations

E.14.19 85681-73-8 CHLOROALKANES, C10-C14

- This chemical was referenced in one source
- No sources mentioned product testing data, or provided concentration data
- One source cited use in consumer products (paints, adhesives, sealants)
- According to one source, this chemical is used to make PVC - flex-Flexible polyvinyl chloride
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- According to these sources, this chemical is used in PVC plasticizers, paints, adhesives and sealants, leather fat liquors, and rubber/flame retardants/textiles/polymers (other than PVC)
- One source mentioned this chemical in the context of laws or regulations

E.14.20 97553-43-0 PARAFFINS (PETROLEUM), NORMAL C>10, CHLORO

- This chemical was referenced in one source
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer products
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- No additional uses were identified from these sources

E.14.21 97659-46-6 ALKANES, C10-26, CHLORO

- This chemical was referenced in one source
- No sources mentioned product testing data, or provided concentration data
- No sources cited use in consumer products
- No sources cited reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided estimates of production volumes
- No additional uses were identified from these sources

E.15 LITERATURE SOURCES USED

Arvaniti, O. S., & Kalantzi, O. I. (2021). Determinants of flame retardants in non-occupationally exposed individuals - A review. *Chemosphere, 263*.

Bolinius, D. J., Sobek, A., Löf, M. F., & Undeman, E. (2018). Evaluating the consumption of chemical products and articles as proxies for diffuse emissions to the environment. *Environmental Science: Processes & Impacts, 20*(10), 1427-1440.

Fiedler, H. (2010). Short-chain chlorinated paraffins: production, use and international regulations *Chlorinated paraffins* (pp. 1-40): Springer.Gustavsson, J., Fischer, S., Ahrens, L., & Wiberg, K. (2017). Replacement substances for the brominated flame retardants PBDE, HBCDD, and TBBPA.

Gustavsson, J., Fischer, S., Ahrens, L., & Wiberg, K. (2017). Replacement substances for the brominated flame retardants PBDE, HBCDD, and TBBPA.

Persson, J., Hagberg, J., & Wang, T. (2018). A survey of organic flame retardants and plasticizers in building materials on the Swedish market and their occurrence in indoor environments.

Poma, G., McGrath, T. J., Christia, C., Malarvannan, G., & Covaci, A. (2020). Chapter Four - Emerging halogenated flame retardants in the indoor environment. In J.-E. Oh (Ed.), *Comprehensive Analytical Chemistry* (Vol. 88, pp. 107-140): Elsevier.

Wypych, A., & Wypych, G. (2021). *Databook of Flame Retardants*. Toronto: ChemTech Publishing.

Wypych, G. (2021). *Handbook of Flame Retardants*. Toronto: ChemTech Publishing.

Yusuf, M. (2018). A Review on Flame Retardant Textile Finishing: Current and Future Trends. *Current Smart Materials, 3*(2), 99-108.

Zuiderveen, E. A. R., Slootweg, J. C., & de Boer, J. (2020). Novel brominated flame retardants - A review of their occurrence in indoor air, dust, consumer goods and food. *Chemosphere, 255*, 126816.

APPENDIX F | POLYHALOGENATED BENZENE ALICYCLES

F.1 SUMMARY BY CHEMICAL – PHBAS

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
ALL	**Across all 4 PHBAs**		**1**	**0**	**2**	**NA**	**4**	**2**	**NA**	**NA**	**1**
1025956-65-3	2,4,5,6,7-pentabromo-1,1,3-trimethyl-3-(2,4,6-tribromophenyl)-2,3-dihydro-1H-indene		0	0		high	0.9778	0			
1084889-51-9	4,5,6,7-Tetrabromo-1,1,3-trimethyl-3-(2,3,4,5-tetrabromophenyl)-2,3-dihydro-1H-indene	OctaInd	0	0	1	high	0.9238	7	0%	0%	
155613-93-7	1H-Indene, 2,3-dihydro-1,1,3-trimethyl-3-phenyl-, octabromo deriv.		1	0	1	high	0.9205	8	13%	0%	1
893843-07-7	4,5,6,7-tetrabromo-1,1,3-trimethyl-3-(2,3,4,6-tetrabromophenyl)-2,3-dihydro-1H-indene		0	0		high	0.9471	0			

F.1.1 OVERVIEW

There are four substances in the OFR class "Polyhalogenated benzene alicycles" (PHBAs), with key attributes described in the Summary by Chemical table (For field definitions and color scheme, see Guide to Summary Tables, Appendix B.1). Of these, one is an active TSCA Inventory[11] substance and there are no inactive TSCA substances. Additionally, none of these other substances appear on international inventories reviewed for this study.

During our literature search, we found that two of the four PHBA chemicals, including the single TSCA active inventory substance, are referenced in the literature. The other two are not. The literature citations, however, provided limited information about production or uses for these chemicals. Patent data is similarly limited for this class.

F.1.2 INDUSTRY PRODUCTION AND USE

For the most recent year, 2015, U.S. industry submitted no reports of manufacturing activity for any of these substances. Thus, there are no estimates of U.S. manufacturing or importing volumes.

None of these substances are reportable under the Toxics Release Inventory. Thus, there are no estimates of the quantities of waste managed for these substances.

PHBAs have been cited in only two of the 187 literature sources reviewed, one citation each for CAS Nos. 1084889-51-9 and 155613-93-7.

F.1.3 USE IN CONSUMER AND CHILDREN'S PRODUCTS

The states of Washington and Oregon require industry to report on chemicals of concern in products intended for use by children that are sold in those states. Over the period 2013-2020, no reports were submitted indicating use of PHBAs in products intended for use by children.

Overall, it appears that substances in this class are not in common use and are unlikely to appear in products intended for consumers or children.

There were no sources that identified concentration data for any product in this class, or any use information for that matter.

[11] The Toxic Substances Control Act (TSCA) Inventory is a list of chemical substances manufactured in or imported to the United States at some time since June 2006. For more information see https://www.epa.gov/tsca-inventory/tsca-inventory-notification-active-inactive-rule

F.2 PHBAS ON NATIONAL AND INTERNATIONAL INVENTORIES AND REGISTRIES

Chemicals in class: 4

- 1 active on TSCA Inventory (recently manufactured/imported in U.S.)[12]
- 0 inactive on TSCA Inventory (no longer manufactured/imported in U.S.)
- 2 not on TSCA Inventory (never manufactured/imported in U.S.)

PHBAS ON THE TSCA ACTIVE INVENTORY	
155613-93-7	1H-Indene, 2,3-dihydro-1,1,3-trimethyl-3-phenyl-, octabromo deriv.
PHBAS ON THE TSCA INACTIVE INVENTORY	
None	

OTHER PHBAS ON INTERNATIONAL REGISTRIES		
None		

F.3 U.S. MANUFACTURING AND IMPORTING ACTIVITY, 2015

NUMBER OF REPORTS BY ACTIVITY TYPE						
PHBAS	MANUFACTURE	IMPORT	BOTH MANUFACTURE AND IMPORT	NOT SPECIFIED	CBI	TOTAL
None						

Source: U.S. EPA, CDR (2016).

F.4 U.S. MANUFACTURING AND IMPORTING VOLUMES, 2015

REPORTED VOLUMES BY ACTIVITY TYPE					
PHBAS	MANUFACTURE	IMPORT	PRODUCTION VOLUME (MANUFACTURE + IMPORT)	USED	EXPORTED
None					

-- data CBI or otherwise not disclosed
Source: U.S. EPA, CDR (2016).

[12] "Active" indicates that U.S. manufacturing or importing activity has been reported since June 2006.

F.5 U.S. PRODUCTION VOLUME TRENDS, 2012-2015

PHBAS	PV 2015	PV 2014	PV 2013	PV 2012
None				

-- data CBI or otherwise not disclosed
PV = manufacturing plus importing
Source: U.S. EPA, CDR (2016).

F.6 TYPE OF PROCESSING OR USE REPORTS, 2015

NUMBER OF REPORTS								
PHBAS	Processing as a Reactant	Processing—Incorporation Into Article	Processing—Incorporation Into Formulation, Mixture, or Reaction Product	Processing—Repackaging	Use—Non-Incorporative Activities	CBI	NKRA	Grand Total
None								

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

F.7 INDUSTRIAL USE REPORTS, 2015

	NUMBER OF REPORTS																								
PHBAS	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
None																									
USED AS FLAME RETARDANT																									
None																									

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

F.8 INDUSTRIAL FUNCTION REPORTS, 2015

NUMBER OF REPORTS															
PHBAS	Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Other	Paint Additives and Coating Additives Not Described by Other Categories	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	CBI	NKRA	Grand Total
None															

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

F.9 INDUSTRIAL SECTOR REPORTS, 2015

NUMBER OF REPORTS: POLYHALOGENATED BENZENE ALICYCLES																									
PHBA	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
ALL INDUSTRIAL FUNCTIONS																									
None																									
USED AS FLAME RETARDANT																									
None																									

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

F.10 CONSUMER AND CHILDREN'S PRODUCT USE REPORTS, 2015

NUMBER OF REPORTS						
PHBAS	COMMERCIAL	CONSUMER	CONSUMER AND COMMERCIAL	NKRA	CBI	TOTAL
None						

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

PHBAS	CHILDREN'S PRODUCT USE	NKRA	OTHER USE	TOTAL
None				

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

F.11 TOXIC RELEASE INVENTORY REPORTS

TRI-REPORTABLE CHEMICALS	
None	

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TOTAL PRODUCTION-RELATED WASTE REPORTED							
PHBAS		2015	2016	2017	2018	2019	GRAND TOTAL
None	No. of Reports						
	Pounds of waste managed						

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TRI Reports by Industry:

None

F.12 HIGH PRIORITY CHEMICALS DATA SYSTEM REPORTS

NUMBER OF REPORTS BY YEAR											
PHBAS		2012	2013	2014	2015	2016	2017	2018	2019	2020[1]	TOTAL
None	Total										
	FR										
	Conc>0.1%										

[1] Partial year reporting.
Source: Interstate Chemicals Clearinghouse (2021).

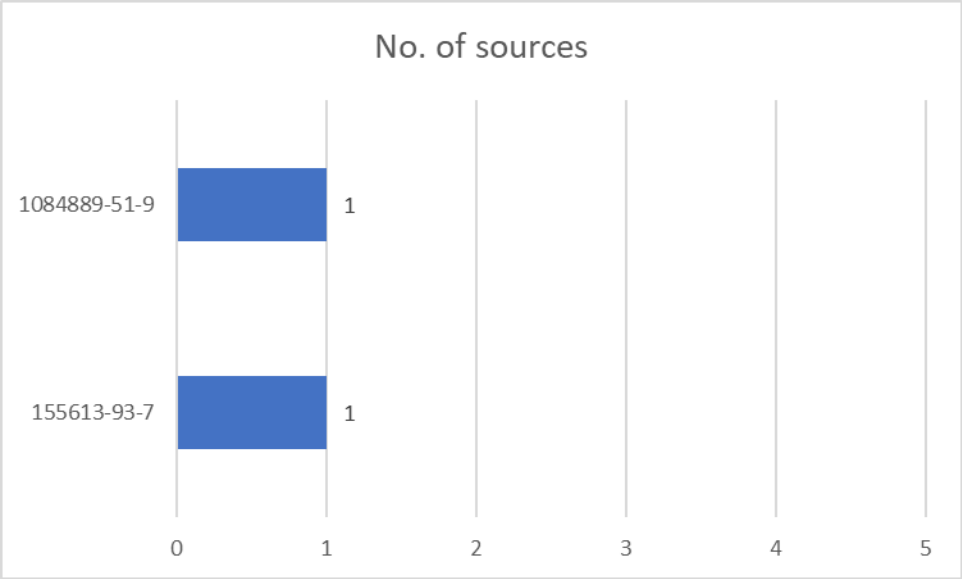
F.13 PATENT COUNTS FROM PUBCHEM

		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
155613-93-7	53785751	0	7	1	**8**	0	1	0	**1**	0	0	0	**0**
893843-07-7	10898209	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
1025956-65-3	11158772	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
1084889-51-9	71751282	0	7	0	**7**	0	5	0	**5**	0	2	0	**2**

Source: PubChem Patent Data (See Exhibit 2-1 in main report and on OFR_universe_wPCPy_10122021.xlsx, tab 'Patent Info by CID' in Supplemental Information)

F.14 PHBAS CITED IN LITERATURE REVIEW

A literature search was conducted to identify sources with information about chemicals in this OFR class (see Chapter 3). PHBAs are mentioned or referenced in two of the 187 sources reviewed.



F.14.1 155613-93-7 1H-INDENE, 2,3-DIHYDRO-1,1,3-TRIMETHYL-3-PHENYL-, OCTABROMO DERIV.

- This chemical was referenced in one source
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided information on uses for this chemical
- One source mentioned laws and regulations

F.14.2 1084889-51-9 4,5,6,7-TETRABROMO-1,1,3-TRIMETHYL-3-(2,3,4,5-TETRABROMOPHENYL)-2,3-DIHYDRO-1H-INDENE

- This chemical was referenced in one source
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided information on uses for this chemical
- One source mentioned laws and regulations

F.15 LITERATURE SOURCES USED

Wypych, G. (2021). *Handbook of Flame Retardants*. Toronto: ChemTech Publishing.

Zuiderveen, E. A. R., Slootweg, J. C., & de Boer, J. (2020). Novel brominated flame retardants - A review of their occurrence in indoor air, dust, consumer goods and food. *Chemosphere, 255*, 126816.

APPENDIX G | POLYHALOGENATED BENZENE ALIPHATICS AND FUNCTIONALIZED

G.1 SUMMARY BY CHEMICAL – PHBZAFS

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
ALL	**Across all 18 PHBZAFs (20 with mixed class)**		**5**	**8**	**12**	**NA**	**17**	**17**	**NA**	**NA**	**7**
147-82-0	2,4,6-Tribromoaniline	BRN 2209258	1	1		med	0.4104	1,172	52%	39%	1
168434-45-5	2,4,6-tribromo-3-(tetrabromopentadecyl)-phenol		0	0	1	high		No CID			
23488-38-2	2,3,5,6-Tetrabromo-p-xylene	BRN 2097341	0	1	2	high	0.8257	207	63%	67%	1
31611-84-4	1-Pentanone, 2,3,4,5-tetrabromo-1,5-diphenyl-		0	1		low	0.9349	3	0%		
31780-26-4	Benzene, dibromoethenyl-		0	0	3	high	0.4404	13,360	67%	64%	
38521-51-6	1,2,3,4,5-Pentabromo-6-(bromomethyl)benzene		0	0	1	high	0.9734	151	91%	97%	1
39568-99-5	3,6-Bis(bromomethyl)-1,2,4,5-tetrabromobenzene		0	0		med	0.9348	15	53%	75%	
39569-21-6	2,3,4,5-Tetrabromo-6-chlorotoluene		0	0	1	high	0.9458	27	85%	86%	
497107-13-8	1,1'-[Oxybis(methylene)]bis(pentabromobenzene)		0	0	1	high	0.9081	20	95%	94%	
57011-47-9	Pentabromophenyl benzoate		0	0	1	med	0.9387	63	90%	92%	
58495-09-3	1,2,3,4,5-Pentabromo-6-(chloromethyl)benzene		0	0	1	high	0.9734	52	62%	61%	
59447-55-1	(Pentabromophenyl)methyl acrylate		1	1	5	high	0.9528	4,024	87%	83%	2
61368-34-1	Tribromostyrene (mixed isomers)		0	0		med	0.7475	5,873	73%	51%	
84852-53-9	1,1'-Ethane-1,2-diylbis(pentabromobenzene)	FIREMASTER 2100; Saytex 8010	3.5	1	23	high	0.9507	1,008	94%	93%	6
85-22-3	2,3,4,5,6-Pentabromoethylbenzene	BRN 3133073	0	2	9	high	0.9507	390	76%	78%	2
855992-98-2	(rel)-(1R,2R,3S,4S)-1,2,3,9-tetrabromo-1,2,3,4-tetrahydro-1,4-methanonaphthalene		0	0		med	0.934	0			
855993-01-0	(rel)-(1R,2S,3S,4S)-1,2,3,9-tetrabromo-1,2,3,4-tetrahydro-1,4-methanonaphthalene		0	0		med	0.934	0			
875-73-0	Tribromostyrene		0	0		low	0.7475	5,873	73%	51%	
87-83-2	Pentabromotoluene	Flammex 5bt; FR-705	1	1	8	high	0.9458	3,482	70%	71%	3

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
93-52-7	1,2-dibromo(phenyl)ethane	Dowspray 9; Styrene dibromide	1	1		med	0.9633	1,915	79%	76%	

Note: 855992-98-2 and 855993-01-0 are listed in both PHBzAFs and PHCCs

G.1.1 OVERVIEW

There are 18 substances in the OFR class "Polyhalogenated benzene aliphatics and functionalized" (PHBzAFs), with key attributes described in the Summary by Chemical table (For field definitions and color scheme, see Guide to Summary Tables, Appendix B.1). Of these, five are active TSCA Inventory[13] substances and another three are inactive. None of the remaining substances appear on other international inventories reviewed for this report. Two additional compounds are cross-listed with polyhalogenated carbocycles.

During our literature search, we found that three of the five PHBzAF chemicals found on the TSCA active inventory are referenced in the literature. Two chemicals that are inactive on the TSCA Inventory was also referenced, as well as seven chemicals not found on any inventory we reviewed. Patent data from PubChem reported information on 17 PHBzAF chemicals. The 12 PHBzAF chemicals with information from literature review also had information from database sources.

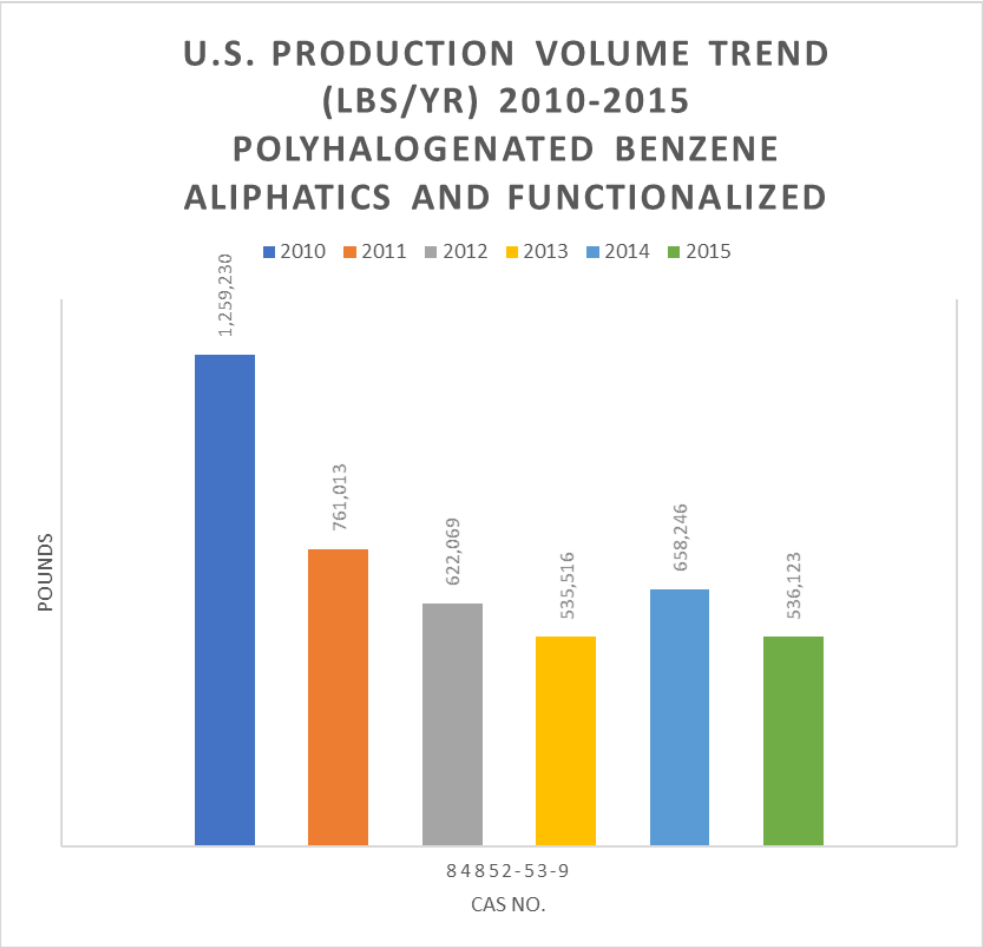
G.1.2 INDUSTRY PRODUCTION AND USE

Most of the available information from EPA focuses on a single PHBzAF chemical, CAS No. 84852-53-9 (an active TSCA Inventory substance). For the most recent year, 2015, U.S. industry submitted two reports of manufacturing activity, six reports of importing activity, and six additional reports where the activity was not specified or was claimed as CBI, all for CAS No. 84852-53-9.

Total reported production volume (manufacturing plus importing) for CAS No. 84852-53-9 in 2015 was 536,123 pounds. PV trend data for 2010-2015 indicates the PV has fluctuated in recent years between 535,000 and 1.2 million pounds per year, averaging 728,000 pounds over this period. Historical data from EPA indicate the reported PV for this chemical in 2006 was between 10 and 50 million pounds. In the literature, one source indicates the global production of CAS No. 87-83-2 was between 1,000 and 5,000 tonnes (high production volume) while another source cited production of CAS No. 59447-55-1 at between 100 and 1,000 tonnes (medium production volume).

Industry identified 16 processing and use activities for these substances in 2015, of which 11 involved processing or use as a flame retardant. Leading uses as a flame retardant included plastics product manufacturing (6 reports) and plastic material and resin manufacturing (4 reports).

[13] The Toxic Substances Control Act (TSCA) Inventory is a list of chemical substances manufactured in or imported to the United States at some time since June 2006. For more information see https://www.epa.gov/tsca-inventory/tsca-inventory-notification-active-inactive-rule



Source: U.S. EPA, CDR (2011-2016).

Nine reports for CAS No. 84852-53-9 identified a consumer/commercial use but there were no CDR reports of any children's product uses. Consumer/commercial uses included electrical and electronic products (3 reports), building/construction materials not covered elsewhere (1 report), fabric, textile, and leather products not covered elsewhere (1 report), and plastic and rubber products not covered elsewhere (1 report). Literature sources also indicate multiple consumer uses, as well as some children's product uses for PHBzAF chemicals.

None of the chemicals in this class are reportable under the Toxics Release Inventory; thus, there are no data available on the waste volume managed for these chemicals.

G.1.3 USE IN CONSUMER AND CHILDREN'S PRODUCTS

The states of Washington and Oregon require industry to report on chemicals of concern in products intended for use by children that are sold in those states. Over the period 2012-2020, 22 reports were submitted for DBDPE (CAS No. 84852-53-9); 10 of these indicated the chemical function in each product was "flame retardant," and in three of these reports the concentration in the final product exceeded 0.1 percent. Products falling into this group included baby safety protection products, toys (ride-on, powered), and dolls/soft toys.

Use of DBDPE (CAS No. 84852-53-9) as a flame retardant in concentrations greater than 0.1 percent, is reported to be used in the following components of children's products:

- Synthetic Polymers (synthetic rubber, plastics, foams etc.)

PHBzAFs have been cited in 25 of the 187 literature sources reviewed. Among the 12 PHBzAFs cited, chemicals appearing in the greatest number of these sources include: CAS No. 84852-53-9 (23 sources), CAS No. 85-22-3 (9 sources), CAS No. 87-83-2 (8 sources), and CAS No. 59447-55-1 (5 sources). Several sources report the results of product testing, and these indicate PHBzAFs have been found in a variety of consumer and/or children's products, such as:

- Television casings (16 percent)
- hard plastic toys (such as racing cars, vehicles, weapons, action figures, and hand-held video game consoles), foam toys (such as mats, puzzles, and swords), rubber/ soft plastic toys (such as Barbie dolls and teethers), and textile and stuffed toys (such as animals, dolls, and Christmas toys) all combined to have a median concentration of 0.000554 percent
- electronic appliances, furniture and upholstery, car interiors, and raw materials for electronics (0.0000311 to 0.0268 percent)
- children's toys (0.000000003 to 0.000003 percent)
- electronic and electrical equipment and waste electronic and electrical equipment (maximum 0.034%)
- kitchen utensils (0.00000002 to 0.00072 percent)

Uses for PHBzAFs identified through the literature review (as described in Chapter 3) include:

CAS No. 84852-53-9: electronic appliances, furniture and upholstery, car interiors, and raw materials for electronics; household/office furniture/furnishings, baby care, home appliances, clothing, toys/games, electrical supplies, building products, communications, computing, camping, storage/haulage containers, audio visual/photography, beauty/personal care/hygiene, cleaning/hygiene products, automotive, fuels, home/business safety/security/surveillance, lawn/garden supplies, tobacco/smoking accessories, household/office furniture, stationery/office machinery/occasion supplies, pet care; curtains; stoppers and lids from thermo cups, kitchen utensils; racing cars, vehicles, weapons, action figures, and hand-held video game consoles), foam toys (such as mats, puzzles, and sword), rubber/ soft plastic toys (such as Barbie dolls and teethers), and textile and stuffed toys (such as animals, dolls, and Christmas toys); infant car seats; television casings; polyolefin and styrenic resins; rigid plastic, flexible PUF, textiles, flexible plastic/rubber, polyvinyl chloride; stereo and video electronics.

CAS No. 85-22-3: circuit boards; textiles; adhesives, wire and cable coatings and polyurethane foam, thermoplastic resins; kitchen utensils.

CAS No. 87-83-5: textiles, polyester resins, paint emulsions, polyethylene, polypropylene, polystyrenes, rubbers; children's toys; polystyrene, polyethylene, and polypropylene.

CAS No. 59447-55-1: curtains; polybutylene terephthalate and polyethylene terephthalate.

G.2 PHBZAFS ON NATIONAL AND INTERNATIONAL INVENTORIES AND REGISTRIES

Chemicals in class: 18

- 5 active on TSCA Inventory (recently manufactured/imported in U.S.)[14]
- 3 inactive on TSCA Inventory (no longer manufactured/imported in U.S.)
- 10 not on TSCA Inventory (never manufactured/imported in U.S.)

PHBZAFS ON THE TSCA ACTIVE INVENTORY	
87-83-2	Pentabromotoluene
93-52-7	1,2-dibromo(phenyl)ethane
147-82-0	2,4,6-Tribromoaniline
59447-55-1	(Pentabromophenyl)methyl acrylate
84852-53-9	1,1'-Ethane-1,2-diylbis(pentabromobenzene)
PHBZAFS ON THE TSCA INACTIVE INVENTORY	
85-22-3	2,3,4,5,6-Pentabromoethylbenzene
23488-38-2	2,3,5,6-Tetrabromo-p-xylene
31611-84-4	1-Pentanone, 2,3,4,5-tetrabromo-1,5-diphenyl-

Source: U.S. EPA, CDR (2016).

OTHER PHBZAFS ON INTERNATIONAL REGISTRIES		
None		

Source: U.S. EPA, CDR (2016).

G.3 U.S. MANUFACTURING AND IMPORTING ACTIVITY, 2015

NUMBER OF REPORTS BY ACTIVITY TYPE						
PHBZAFS	MANUFACTURE	IMPORT	BOTH MANUFACTURE AND IMPORT	NOT SPECIFIED	CBI	TOTAL
84852-53-9	2	6		1	5	14

Source: U.S. EPA, CDR (2016).

[14] "Active" indicates that U.S. manufacturing or importing activity has been reported since June 2006.

G.4 U.S. MANUFACTURING AND IMPORTING VOLUMES, 2015

REPORTED VOLUMES BY ACTIVITY TYPE					
PHBZAFS	MANUFACTURE	IMPORT	PRODUCTION VOLUME (MANUFACTURE + IMPORT)	USED	EXPORTED
84852-53-9	-	536,123	536,123	-	250,000

-- data CBI or otherwise not disclosed
Source: U.S. EPA, CDR (2016).

G.5 U.S. PRODUCTION VOLUME TRENDS, 2012-2015

PHBZAFS	PV 2015	PV 2014	PV 2013	PV 2012
84852-53-9	536,123	658,246	535,516	622,069

-- data CBI or otherwise not disclosed
PV = manufacturing plus importing
Source: U.S. EPA, CDR (2016).

G.6 TYPE OF PROCESSING OR USE REPORTS, 2015

NUMBER OF REPORTS								
PHBZAFS	Processing as a Reactant	Processing—Incorporation Into Article	Processing—Incorporation Into Formulation, Mixture, or Reaction Product	Processing—Repackaging	Use—Non-Incorporative Activities	CBI	NKRA	Grand Total
84852-53-9		4	7		2	3		16

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

G.7 INDUSTRIAL USE REPORTS, 2015

NUMBER OF REPORTS																							
PHBZAFS	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
84852-53-9							1									4	6			1		4		16
USED AS FLAME RETARDANT																								
84852-53-9							1									4	5			1				11

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

G.8 INDUSTRIAL FUNCTION REPORTS, 2015

NUMBER OF REPORTS															
PHBZAFS	Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Other	Paint Additives and Coating Additives Not Described by Other Categories	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	CBI	NKRA	Grand Total
84852-53-9		1		11									4		16

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

G.9 INDUSTRIAL SECTOR REPORTS, 2015

NUMBER OF REPORTS: POLYHALOGENATED BENZENE ALIPHATICS AND FUNCTIONALIZED																							
PHBZAF	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, And Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
ALL INDUSTRIAL FUNCTIONS																							
Total							1									4	6			1		4		16
84852-53-9							1									4	6			1		4		16
USED AS FLAME RETARDANT																							
Total							1									4	5			1				11
84852-53-9							1									4	5			1				11

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

G.10 CONSUMER AND CHILDREN'S PRODUCT USE REPORTS, 2015

NUMBER OF REPORTS						
PHBZAFS	COMMERCIAL	CONSUMER	CONSUMER AND COMMERCIAL	NKRA	CBI	TOTAL
84852-53-9	3		9	1	1	14

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

Reports in the "Consumer and Commercial" column for Cas No. 84852-53-9 were for use in *electrical and electronic products* (3 reports), *building/construction materials not covered elsewhere* (1 report), *fabric, textile, and leather products not covered elsewhere* (1 report), and *plastic and rubber products not covered elsewhere* (1 report).

PHBZAFS	CHILDREN'S PRODUCT USE	NKRA	OTHER USE	TOTAL
84852-53-9		2	12	14

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

G.11 TOXIC RELEASE INVENTORY REPORTS

TRI-REPORTABLE CHEMICALS	
None	

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TOTAL PRODUCTION-RELATED WASTE REPORTED							
PHBZAFS		2015	2016	2017	2018	2019	GRAND TOTAL
None	No. of Reports						
	Pounds of waste managed						

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TRI Reports by Industry:

None

G.12 HIGH PRIORITY CHEMICALS DATA SYSTEM REPORTS

NUMBER OF REPORTS BY YEAR											
PHBZAFS		2012	2013	2014	2015	2016	2017	2018	2019	2020[1]	TOTAL
84852-53-9	Total							7	10	5	22
	FR								6	4	10
	Conc>0.1%								1	2	3

[1] Partial year reporting.
Products reported at concentrations above 0.1 percent were in the following categories: *baby safety protection, non-powered (1 report); toys - ride-on, powered (1 report); and dolls/soft toys, non-powered (1 report).*
Source: Interstate Chemicals Clearinghouse (2021).

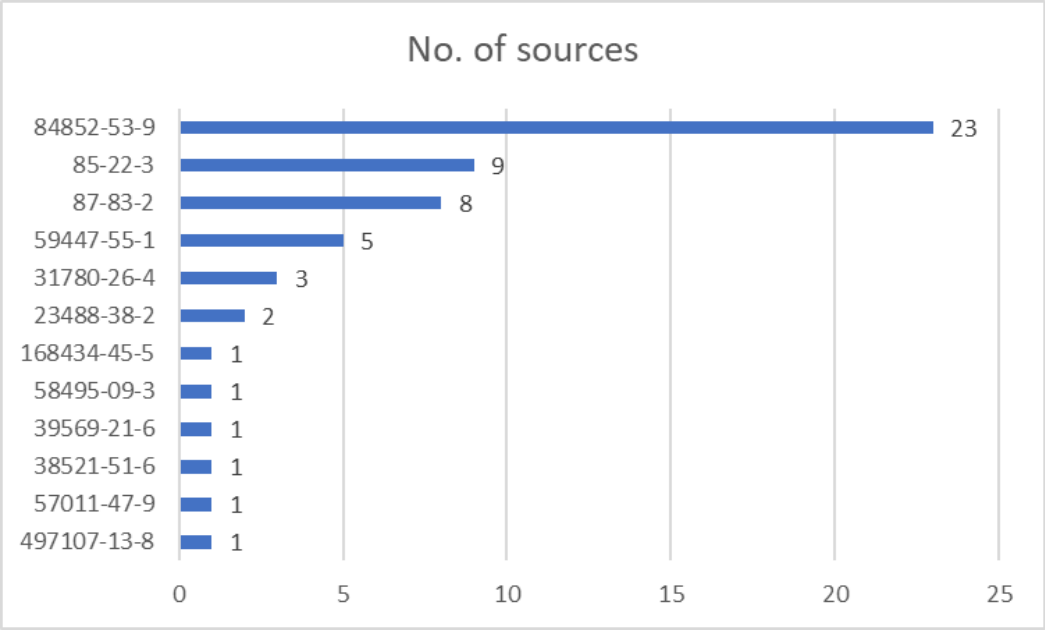
G.13 PATENT COUNTS FROM PUBCHEM

		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
85-22-3	6800	5	87	298	**390**	1	40	147	**188**	0	33	80	**113**
87-83-2	6906	222	822	2,438	**3,482**	104	252	875	**1,231**	62	161	446	**669**
93-52-7	7145	50	349	1,516	**1,915**	5	71	238	**314**	2	44	128	**174**
147-82-0	8986	189	372	611	**1,172**	29	14	27	**70**	17	12	9	**38**
875-73-0	10382659	42	1,566	4,265	**5,873**	12	374	398	**784**	5	254	171	**430**
31780-26-4	161726	242	4,166	8,952	**13,360**	13	572	1,047	**1,632**	5	382	538	**925**
23488-38-2	31952	32	45	130	**207**	12	4	32	**48**	1	2	21	**24**
31611-84-4	3084547	3	0	0	**3**	0	0	0	**0**	0	0	0	**0**
38521-51-6	3015989	3	11	137	**151**	0	2	63	**65**	0	0	49	**49**
39568-99-5	3016090	3	4	8	**15**	2	0	6	**8**	0	0	6	**6**
39569-21-6	38294	2	2	23	**27**	2	1	19	**22**	0	1	8	**9**
57011-47-9	13840524	1	5	57	**63**	1	3	47	**51**	1	2	29	**32**
58495-09-3	57838204	17	3	32	**52**	7	0	11	**18**	3	0	9	**12**
59447-55-1	101059	20	501	3,503	**4,024**	5	180	931	**1,116**	3	115	493	**611**
61368-34-1	10382659	42	1,566	4,265	**5,873**	12	374	398	**784**	5	254	171	**430**
84852-53-9	10985889	0	61	947	**1,008**	0	28	378	**406**	0	22	155	**177**
168434-45-5	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
497107-13-8	15525539	0	1	19	**20**	0	1	16	**17**	0	1	16	**17**
855992-98-2	154735127	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
855993-01-0	154735128	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**

Source: PubChem Patent Data (See Exhibit 2-1 in main report and on OFR_universe_wPCPy_10122021.xlsx, tab 'Patent Info by CID' in Supplemental Information)

G.14 PHBZAFS CITED IN LITERATURE REVIEW

A literature search was conducted to identify sources with information about chemicals in this OFR class (see Chapter 3). PHBzAFs are mentioned or referenced in 25 of the 187 sources reviewed.



In this section, the following OECD use codes for chemicals are listed according to the internationally harmonized functional, product and article use categories[15]:

- AC1a. Complex articles. Road Vehicles for passengers and goods. Examples: Cars, trucks, vans.
- AC5e. Fabrics, textiles, and apparel. Furniture & furnishings, including furniture coverings. Examples: Sofa cover, car seat cover, fabric chair, hammock.
- AC10d. Rubber articles. Articles intended for food contact. Examples: Plates, utensils.
- AC13b. Plastic articles (hard). Toys intended for children's use (and child dedicated articles). Examples: Toys (dolls, car, animals, teething rings).
- AC13d. Plastic articles (hard). Articles intended for food contact. Examples: Plastic dinner ware, food storage.
- AC13e. Plastic articles (hard). Furniture & furnishings, including furniture coverings. Examples: Computer casing.

G.14.1 84852-53-9 1,1'-ETHANE-1,2-DIYLBIS(PENTABROMOBENZENE)

- This chemical was referenced in 23 sources

[15] Source: OECD (2017).

- Twelve sources mentioned product testing data and nine of them included concentration data
    - Televisions: 16 percent
    - Hard plastic toys: median concentration of 0.000554 percent
    - Rubber and soft plastic toys: below the level of detection
    - Foam toys: 0.0719 percent
    - Textiles and stuffed toys: 0.0103 percent
    - household products in the Pearl River Delta, South China, including electronic appliances, furniture and upholstery, car interiors, and raw materials for electronics: ranged from 0.0000311 to 0.0268 percent
    - Children's toys: mean concentration of 0.000003 percent
    - No detectable concentrations found in vehicles, construction, or textiles
    - E-waste: 0.034 percent
    - Kitchen utensils: <0000009.2 - 0.0072 percent
    - Shredders: median concentration of 0.0875 percent
- Eleven sources mentioned use in consumer products and five sources cited use in children's products
- Sources indicated that this chemical was used in the following resins: EPS-Expanded polystyrene, HIPS-High-impact polystyrene, and PU-Polyurethanes
- Eight sources reported human or environmental exposure data
- OECD use codes for this chemical included AC1a, AC5e, AC10d, AC13b, AC13d, AC13e
- Two sources cited global production of 10,000-100,000 tonnes annually (high production volume), another cited Germany's production to be 1,000 to 5,000 tonnes in 2001, while one source mentioned that EU production was around 2,500 tonnes annually
- According to these sources, this chemical has been used:
    - As an additive in the manufacture of plastics, such as high-impact polystyrene, acrylonitrile butadiene styrene, polypropylene, in rubber products, adhesives and sealants, in different applications related to manufacture of textiles, such as cotton, polyester, vinyl ester resin, and leather, as well as in polymeric materials used for electronic and electrical purposes
    - In materials like plastics, rubber, and polymers used in electronic and electrical equipment, furniture and upholstery, car interiors, infant's car seats, and raw materials for electronics, curtains, thermo cups, kitchen utensils, children's toys, textiles, television casings, styrenic resins, high impact polystyrenes, rigid plastic, PVC, acrylonitrile butadiene styrene, polypropylene, in rubber products, adhesives and sealants, in different applications related to manufacture of textiles, such as cotton, polyester, vinyl ester resin, and leather, household/office furniture, baby care, home appliances, building products, camping, storage/haulage containers, beauty/personal care products, fuels, lawn/garden supplies, tobacco/smoking accessories, and pet care products
- Two sources mentioned this chemical in the context of use trends over time and two sources mentioned this chemical with consideration to substitutes or alternatives
- Three sources mentioned this chemical in the context of end of life issues and five sources mentioned this chemical in relation to laws and regulations

G.14.2 85-22-3 2,3,4,5,6-PENTABROMOETHYLBENZENE

- This chemical was referenced in 12 sources
- Four sources mentioned product testing data and included concentration data
    - No detectable concentrations found in e-waste, vehicles, construction, or textiles
    - Children's toys: mean concentration of 0.000000003 percent
    - Kitchen utensils: range of <0.0000002 to 0.0000033 percent
    - Dishcloths: mean concentration of 0.012ng per dishcloth
- Two sources cited use in consumer products (circuit boards; CRTs, TVs, PCs, AV devices, small household appliances) but did not mention use in children's products
- Two sources reported human or environmental exposure data
- OECD use codes for this chemical included AC10d, AC13e
- One source indicated that EU production was estimated to be between 10 and 1,000 tonnes in 2002
- According to these sources, this chemical is used in thermoset polyester resins (circuit boards, textiles, adhesives, wire and cable coatings and polyurethane foam), thermoplastic resins, and kitchen utensils
- One source mentioned this chemical in the context of use trends over time
- Two sources mentioned this chemical in the context of end of life issues and two sources mentioned this chemical in relation to laws and regulations

G.14.3 87-83-2 PENTABROMOTOLUENE

- This chemical was referenced in 11 sources
- Five sources mentioned product testing data and several included concentration data
    - No detectable concentrations found in e-waste, vehicles, construction, or textiles
    - Children's toys: mean concentration of 0.000003 percent
    - Dishcloths: 16ng per dishcloth
- One source cited use in consumer products (CRTs, TVs, PCs, AV devices, small household appliances) but did not mention use in children's products
- Two sources reported human or environmental exposure data
- OECD use codes for this chemical included AC13e
- One source cited global production of this chemical to be 1,000 to 5,000 tonnes annually (high production volume)
- According to these sources, this chemical is used in textiles, polyester resins, paint emulsions, polyethylene, polypropylene, polystyrenes, rubbers, polystyrene, polyethylene, polypropylene, and children's toys
- One source mentioned this chemical in the context of use trends over time
- One source mentioned this chemical in the context of end of life issues and two sources mentioned this chemical in relation to laws and regulations

G.14.4 59447-55-1 (PENTABROMOPHENYL)METHYL ACRYLATE

- This chemical was referenced in 7 sources
- One source mentioned product testing data but did not include concentration data

- One source cited use in consumer products (curtains) but did not mention use in children's products
- One source reported human or environmental exposure data
- OECD use codes for this chemical included AC5e.
- One source cited global production of 100-1,000 tonnes annually (medium production volume)
- According to these sources, this chemical is used in polybutylene terephthalate, polyethylene terephthalate, and curtains
- Sources indicated that this chemical is used in polybutylene terephthalate and polyethylene terephthalate as well as curtains
- One source mentioned this chemical in the context of use trends over time

G.14.5 31780-26-4 BENZENE, DIBROMOETHENYL-

- This chemical was referenced in 4 sources
- No sources mentioned product testing data or included concentration data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided production volume estimates for this chemical
- No additional uses were identified from these sources
- One source mentioned this chemical in the context of use trends over time

G.14.6 23488-38-2 2,3,5,6-TETRABROMO-P-XYLENE

- This chemical was referenced in two sources
- One source mentioned product testing data and included concentration data
- No detectable concentrations found in e-waste, vehicles, construction, or textiles.
- No sources cited use in consumer or children's products
- One source reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided production volume estimates for this chemical
- No additional uses were identified from these sources
- One source mentioned this chemical in the context of end of life issues

G.14.7 168434-45-5 2 2,4,6-TRIBROMO-3-(TETRABROMOPENTADECYL)-PHENOL

- This chemical was referenced in one source
- No sources mentioned product testing data or included concentration data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided production volume estimates for this chemical
- No additional uses were identified from these sources
- No sources mentioned this chemical in the context of use trends over time, substitutes, end of life issues, or laws or regulations.

G.14.8 38521-51-6 1,2,3,4,5-PENTABROMO-6-(BROMOMETHYL)BENZENE

- This chemical was referenced in one source
- No sources mentioned product testing data or included concentration data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided production volume estimates for this chemical
- No additional uses were identified from these sources
- No sources mentioned this chemical in the context of use trends over time, substitutes, end of life issues, or laws or regulations.

G.14.9 39569-21-6 2,3,4,5-TETRABROMO-6-CHLOROTOLUENE

- This chemical was referenced in one source
- No sources mentioned product testing data or included concentration data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided production volume estimates for this chemical
- No additional uses were identified from these sources
- No sources mentioned this chemical in the context of use trends over time, substitutes, end of life issues, or laws or regulations.

G.14.10 497107-13-8 1,1'-[OXYBIS(METHYLENE)]BIS(PENTABROMOBENZENE)

- This chemical was referenced in one source
- No sources mentioned product testing data or included concentration data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided production volume estimates for this chemical
- No additional uses were identified from these sources
- No sources mentioned this chemical in the context of use trends over time, substitutes, end of life issues, or laws or regulations.

G.14.11 57011-47-9 PENTABROMOPHENYL BENZOATE

- This chemical was referenced in one source
- No sources mentioned product testing data or included concentration data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided production volume estimates for this chemical
- No additional uses were identified from these sources
- One source mentioned this chemical in the context of use trends over time

G.14.12 58495-09-3 1,2,3,4,5-PENTABROMO-6-(CHLOROMETHYL)BENZENE

- This chemical was referenced in one source
- No sources mentioned product testing data or included concentration data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided production volume estimates for this chemical
- No additional uses were identified from these sources
- No sources mentioned this chemical in the context of use trends over time, substitutes, end of life issues, or laws or regulations.

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APPENDIX H | POLYHALOGENATED BENZENES

H.1 SUMMARY BY CHEMICAL - PHBS

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
ALL	**Across all 50 PBBs**		**8**	**27**	**15**	**NA**	**49**	**25**	**NA**	**NA**	**25**
115245-07-3	1,1'-Biphenyl, 2,4,5-tribromo-	PBB-29	0	1	1	med	0.9859	0			1
119264-59-4	1,1'-Biphenyl, 2,2',3,3',4,4',6,6'-octabromo-	PBB-197	0	0		low	0.9947	0			
119264-60-7	2,2',3,3',4,5',6,6'-Octabromobiphenyl		0	0		low	0.9947	0			
119264-61-8	2,2',3,4,4',5,6,6'-Octabromobiphenyl		0	0		low	0.9947	0			
119264-62-9	2,2',3,3',4,4',5,6,6'-Nonabromo-1,1'-biphenyl	PBB 207; Bromkal 80-9D	0	0	1	med	0.9947	50	70%	44%	
119264-63-0	2,2',3,3',4,5,5',6,6'-Nonobromobiphenyl	PBB-208	0	0		med	0.9947	5	80%		
13654-09-6	1,1'-Biphenyl, 2,2',3,3',4,4',5,5',6,6'-decabromo-	PBB-209	0	2	5	high	0.9947	2,516	56%	59%	3
14957-65-4	4,4',6,6'Tetrabromo2,2'biphenyldiol		0	0		low	0.8816	1	0%		
16400-50-3	1,1'-Biphenyl, 3,3',5,5'-tetrabromo-	PBB-80	0	1	1	high	0.8773	154	79%	11%	1
198126-86-2	Tetrabromo trichloromethyl benzene		0	0	1	low	0.7725	No CID			
2113-57-7	3-Bromobiphenyl		1	1	1	low	0.8003	2,611	70%	50%	1
27858-07-7	Octabromobiphenyl	BB-8	0	2	1	med	0.9947	1,502	46%	48%	3
31710-32-4	p-Tetradecachloroterphenyl		0	0		low	0.9947	0			
36355-01-8	Hexabromobiphenyl		0	2	2	med		No CID			3
42429-88-9	1,1':2',1''-Terphenyl, 2,2'',3,3',3'',4,4',4'',5,5',5'',6,6',6''-tetradecachloro-		0	0		low	0.9947	0			
42429-89-0	1,1':3',1''-Terphenyl, 2,2',2'',3,3'',4,4',4'',5,5',5'',6,6',6''-tetradecachloro-		0	0		low	0.9947	0			
56890-89-2	1,2,3,4,7,7-Hexachloro-5-(2,4,6-tribromophenyl)bicyclo[2.2.1]hept-2-ene		0	1		low	0.9727	0			
59080-37-4	2,2',5,5'-Tetrabromobiphenyl		0	1		high	0.8553	2	100%		1
59080-39-6	PBB 103		0	1		high	0.9713	0			1
59080-40-9	2,2',4,4',5,5'-Hexabromobiphenyl	PBB-153	0	1	2	high	0.9804	649	39%	41%	2
59080-41-0	2,3,5,6,2',3',5',6'-Octabromobiphenyl	PBB-202	0	0		low	0.9804	0			
59447-57-3	Poly(pentabromobenzyl acrylate)		1	1	4	high	0.9528	4,024	87%	83%	

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
59536-65-1	Polybrominated biphenyls (PBB)	FIREMASTER BP-6	1	0	3	med	0.9857	124	48%	0%	3
59789-51-4	1H-Pyrrole-2,5-dione, 1-(2,4,6-tribromophenyl)-		0	1	1	high	0.6178	391	78%	32%	
60044-24-8	2,2',4,5-Tetrabromo-1,1'-biphenyl	BB-49	0	1		med	0.9804	1	100%		1
60044-25-9	PBB 053		0	0		low	0.9416	0			1
60044-26-0	3,3',4,4',5,5'-Hexabromobiphenyl	PBB-169	0	1		high	0.9652	14	100%		1
608-90-2	Benzene, pentabromo-		0	0	3	med	0.9278	889	64%	70%	
626-39-1	1,3,5Tribromobenzene	PARAGOS 530416	1	1		low	0.832	3,936	79%	75%	2
636-28-2	1,2,4,5Tetrabromobenzene		1	0		low	0.7637	455	73%	100%	
67733-52-2	1,1'-Biphenyl, 2,2',3,4,4',5,5'-heptabromo-	PBB-180	0	0		high	0.9918	0			
67888-96-4	1,1'-Biphenyl, 2,2',4,5,5'-pentabromo-		0	1		high	0.9804	0			1
67888-97-5	2,4,5,3',4'-Pentabromobiphenyl		0	1		med	0.9804	0			1
67888-98-6	2,2',3,4,4',5-Hexabromobiphenyl		0	1		low	0.9918	0			1
67888-99-7	2,3',4,4'5,5'-Hexabromobiphenyl		0	1		low	0.9918	0			
67889-00-3	2,3,4,5,2',3',4',5'-Octabromobiphenyl		0	0		high	0.9918	227	53%	58%	
69278-59-7	1,1'-Biphenyl, 2,2',3,4',5',6-hexabromo-	PBB-149	0	1		low	0.9804	0			1
69278-60-0	2,2',3,3',4,4',5-Heptabromobiphenyl		0	0		low	0.9918	1	0%	0%	
69278-61-1	1,1'-Biphenyl, 2,2',3,3',4,4',5,6'-octabromo-	PBB-196	0	0		low	0.9947	0			
69278-62-2	2,2',3,3',4,4',5,5',6-Nonabromo-1,1'-biphenyl		0	0		high	0.9947	18	61%	54%	
69887-11-2	2,2',3,3',4,5,5',6'-Octabromobiphenyl	PBB-201	0	0		low	0.9918	0			
77102-82-0	PBB 077		0	1		med	0.8178	10	100%	100%	1
79596-31-9	1~2~,1~3~,1~4~,1~5~,1~6~,2~3~,2~4~,3~2~,3~3~,3~4~,3~5~,3~6~Dodecabromo1~1~,2~1~:2~2~,3~1~terphenyl		0	0		low	0.9947	0			
82865-89-2	2,2',3,3',4,4'-Hexabromo-1,1'-biphenyl		0	1		low	0.9857	291	50%	60%	1
83929-69-5	2,2',3,3',5,5',6,6'Octabromo4phenoxy1,1'biphenyl		0	0		low	0.9986	0			
84303-46-8	3,3',4,4',5-Pentabromo-1,1'-biphenyl		0	1		med	0.9652	0			1
84303-48-0	1,1'-Biphenyl, 2,3',4,4',5',6-hexabromo-		0	1		low	0.9923	0			1
87-82-1	Hexabromobenzene		1	1	10	high	0.9278	10,670	53%	57%	2

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
92-66-0	4-Bromobiphenyl	4-Biphenyl bromide; RARECHEM BB AA 0021	1	1		high	0.8003	7,113	77%	69%	1
92-86-4	1,1'-Biphenyl, 4,4'-dibromo-	PBB-15	1	1	1	high	0.7276	4,482	78%	78%	2

H.1.1 OVERVIEW

There are 50 substances in the OFR class "Polyhalogenated benzenes" (PHBs), with key attributes described in the Summary by Chemical table (For field definitions and color scheme, see Guide to Summary Tables, Appendix B.1). Twenty-eight of these substances are reported on one or more chemical inventories we reviewed. Of these, seven are active TSCA Inventory[16] substances and another five are inactive. Six of the seven active and three of the five inactive TSCA Inventory substances appear on other (non-U.S.) inventories. An additional 16 substances not on the TSCA Inventory appear on non-U.S. inventories (specifically, Japan). The remaining 22 substances do not appear on any inventories we reviewed.

During our literature search, we found that while some of the PHB chemicals found on the TSCA active inventory are referenced in the literature, others are not. In our literature search, we were able to collect data for four TSCA active PHB chemicals, four TSCA inactive chemicals, and three PHB chemicals identified in other inventories.

Databases with chemical production and use information were also searched (see Chapter 3). Across all databases, only a single PHB chemical (CAS No. 87-82-1) had some reported use information. The largest database source, patent data from PubChem, reported information on 25 PHB chemicals.

H.1.2 INDUSTRY PRODUCTION AND USE

Although there are seven active and five inactive PHBs on the TSCA Inventory, only one PHB has been reported to the CDR since 1998. That report, submitted in 1998, was for CAS No. 87-82-1. No subsequent reports for this or any other PHBs have been submitted since that time. In that report, the PV was in the 10,000 to 500,000 pound range. Due to the more limited reporting requirements at the time, there is no further information about uses, or even if the PV represented domestic manufacturing or importing activity.

In the literature, PHB chemicals are generally characterized as low production volume chemicals.

Over the period 2015-2019, industry has submitted one report for PHB chemical (CAS No. 59536-65-1) under the Toxics Release Inventory. This report, for 2019, indicates the waste volume managed for this chemical was 1,449 pounds. The industry associated with this report was "iron and steel mills and ferroalloy manufacturing."

H.1.3 USE IN CONSUMER AND CHILDREN'S PRODUCTS

The states of Washington and Oregon require industry to report on chemicals of concern in products intended for use by children that are sold in those states. The reporting tool used by Washington and Oregon is known as the High Priority Chemicals Data System (HPCDS). Over the period 2013-2020, no reports of such use were submitted for any chemicals in this class. One literature source, however, indicates one chemical, CAS No. 59536-65-1, has been used in used in baby textiles, soft non-PVC toys, baby mattresses, diaper-changing mats, feeding chairs, baths, and aprons.

[16] The Toxic Substances Control Act (TSCA) Inventory is a list of chemical substances manufactured in or imported to the United States at some time since June 2006. For more information see https://www.epa.gov/tsca-inventory/tsca-inventory-notification-active-inactive-rule.

PHBs have been cited in 16 of the 187 literature sources reviewed. Among the eight PHBs cited, chemicals appearing in the greatest number of these sources include: CAS No. 87-82-1 (10 sources), CAS No. 13654-09-6 (5 sources), CAS No. 59477-57-3 (4 sources) and CAS Nos. 608-90-2 and 59536-65-1 (3 sources each). Several sources report the results of product testing, and these indicate PHBs have been found in a variety of consumer and/or children's products, such as (reported concentrations in products shown in parentheses):

- Children's toys (mean concentrations between 0.000004 and 0.000016 percent)
- Construction material and textiles (maximum concentration 0.0001 percent)
- Computer casing (0.018 percent)
- Sound insulation cotton (0.0468 percent)
- Decorative laminate (0.0165 percent)
- Foam from car seats (0.000076 percent)
- Fabric from car seats (0.000013 percent)
- Composite from car seats (0.000023 percent)

Uses for PHBs identified through the literature review (as described in Chapter 3) include:

CAS No. 119264-62-9: Typewriter, calculator and microfilm-reader housing; business machine housings; radio and TV parts, thermostats, shaver and hand tool housings; projector housings, movie equipment cases; miscellaneous small automotive parts; electrical-wire connectors, switch connectors, speaker grills; small parts for electrical applications, motor housings; components for industrial equipment.

CAS No. 13654-09-6: insulation, assembly foams, IT devices, upholstered furniture, upholstery foams, mattresses and circuit boards; typewriter, calculator and microfilm-reader housing; business machine housings; radio and TV parts, thermostats, shaver and hand tool housings; projector housings, movie equipment cases; miscellaneous small automotive parts; electrical-wire connectors, switch connectors, speaker grills; small parts for electrical applications, motor housings; components for industrial equipment.

CAS No. 27858-07-7: Typewriter, calculator and microfilm-reader housing; business machine housings; radio and TV parts, thermostats, shaver and hand tool housings; projector housings, movie equipment cases; miscellaneous small automotive parts; electrical-wire connectors, switch connectors, speaker grills; small parts for electrical applications, motor housings; components for industrial equipment.

CAS No. 36355-01-8: Typewriter, calculator and microfilm-reader housing; business machine housings; radio and TV parts, thermostats, shaver and hand tool housings; projector housings, movie equipment cases; miscellaneous small automotive parts; electrical-wire connectors, switch connectors, speaker grills; small parts for electrical applications, motor housings; components for industrial equipment.

CAS No. 59080-40-9: insulation, assembly foams, IT devices, upholstered furniture, upholstery foams, mattresses and circuit boards.

CAS No. 59447-57-3: automotive and electronic.

CAS No. 59536-65-1: polystyrene foam; baby textiles; soft non-PVC toys; baby mattresses; diaper-changing mats; feeding chairs, baths, aprons.

CAS No. 608-90-2: upholstered furniture, electrical and electronic equipment (EEE); children's toys

CAS No. 87-82-1: curtains; upholstered furniture, electrical and electronic equipment (EEE); paper, wood textiles, electronics; plastic; polymers; children's toys.

H.2 PHBS ON NATIONAL AND INTERNATIONAL INVENTORIES AND REGISTRIES

Chemicals in class: 50

- 7 active on TSCA Inventory (recently manufactured/imported in U.S.)[17]
- 5 inactive on TSCA Inventory (no longer manufactured/imported in U.S.)
- 38 not on TSCA Inventory (never manufactured/imported in U.S.)

PHBS ON THE TSCA ACTIVE INVENTORY	
87-82-1	Hexabromobenzene
92-66-0	4-Bromobiphenyl
92-86-4	1,1'-Biphenyl, 4,4'-dibromo-
626-39-1	1,3,5-Tribromobenzene
636-28-2	1,2,4,5-Tetrabromobenzene
2113-57-7	3-Bromobiphenyl
59447-57-3	Poly(pentabromobenzyl acrylate)
PHBS ON THE TSCA INACTIVE INVENTORY	
13654-09-6	1,1'-Biphenyl, 2,2',3,3',4,4',5,5',6,6'-decabromo-
27858-07-7	Octabromobiphenyl
36355-01-8	Hexabromobiphenyl
56890-89-2	1,2,3,4,7,7-Hexachloro-5-(2,4,6-tribromophenyl)bicyclo[2.2.1]hept-2-ene
59789-51-4	1H-Pyrrole-2,5-dione, 1-(2,4,6-tribromophenyl)-

Source: U.S. EPA, CDR (2016).

OTHER PHBS ON INTERNATIONAL REGISTRIES		
115245-07-3	1,1'-Biphenyl, 2,4,5-tribromo-	Japan CSCL
16400-50-3	1,1'-Biphenyl, 3,3',5,5'-tetrabromo-	Japan CSCL
59080-37-4	2,2',5,5'-Tetrabromobiphenyl	Japan CSCL
59080-39-6	PBB 103	Japan CSCL
59080-40-9	2,2',4,4',5,5'-Hexabromobiphenyl	Japan CSCL
60044-24-8	2,2',4,5-Tetrabromo-1,1'-biphenyl	Japan CSCL
60044-26-0	3,3',4,4',5,5'-Hexabromobiphenyl	Japan CSCL
67888-96-4	1,1'-Biphenyl, 2,2',4,5,5'-pentabromo-	Japan CSCL
67888-97-5	2,4,5,3',4'-Pentabromobiphenyl	Japan CSCL
67888-98-6	2,2',3,4,4',5-Hexabromobiphenyl	Japan CSCL
67888-99-7	2,3',4,4'5,5'-Hexabromobiphenyl	Japan CSCL
69278-59-7	1,1'-Biphenyl, 2,2',3,4',5',6-hexabromo-	Japan CSCL
77102-82-0	PBB 077	Japan CSCL
82865-89-2	2,2',3,3',4,4'-Hexabromo-1,1'-biphenyl	Japan CSCL
84303-46-8	3,3',4,4',5-Pentabromo-1,1'-biphenyl	Japan CSCL
84303-48-0	1,1'-Biphenyl, 2,3',4,4',5',6-hexabromo-	Japan CSCL

Source: U.S. EPA, CDR (2016).

[17] "Active" indicates that U.S. manufacturing or importing activity has been reported since June 2006.

H.3 U.S. MANUFACTURING AND IMPORTING ACTIVITY, 2015

NUMBER OF REPORTS BY ACTIVITY TYPE						
PHBS	MANUFACTURE	IMPORT	BOTH MANUFACTURE AND IMPORT	NOT SPECIFIED	CBI	TOTAL
None						

Source: U.S. EPA, CDR (2016).

H.4 U.S. MANUFACTURING AND IMPORTING VOLUMES, 2015

REPORTED VOLUMES BY ACTIVITY TYPE					
PHBS	MANUFACTURE	IMPORT	PRODUCTION VOLUME (MANUFACTURE + IMPORT)	USED	EXPORTED
None					

-- data CBI or otherwise not disclosed
Source: U.S. EPA, CDR (2016).

H.5 U.S. PRODUCTION VOLUME TRENDS, 2012-2015

PHBS	PV 2015	PV 2014	PV 2013	PV 2012
None				

-- data CBI or otherwise not disclosed
PV = manufacturing plus importing
Source: U.S. EPA, CDR (2016).

H.6 TYPE OF PROCESSING OR USE REPORTS, 2015

NUMBER OF REPORTS								
PHBS	Processing as a Reactant	Processing—Incorporation Into Article	Processing—Incorporation Into Formulation, Mixture, or Reaction Product	Processing—Repackaging	Use—Non-Incorporative Activities	CBI	NKRA	Grand Total
None								

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

H.7 INDUSTRIAL USE REPORTS, 2015

NUMBER OF REPORTS																								
PHBS	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
None																								
USED AS FLAME RETARDANT																								
None																								

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

H.8 INDUSTRIAL FUNCTION REPORTS, 2015

NUMBER OF REPORTS															
PHBS	Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Other	Paint Additives and Coating Additives Not Described by Other Categories	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	CBI	NKRA	Grand Total
None															

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

H.9 INDUSTRIAL SECTOR REPORTS, 2015

NUMBER OF REPORTS: POLYHALOGENATED BENZENES																							
PHB	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
ALL INDUSTRIAL FUNCTIONS																							
None																							
USED AS FLAME RETARDANT																							
None																							

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

H.10 CONSUMER AND CHILDREN'S PRODUCT USE REPORTS, 2015

NUMBER OF REPORTS						
PHBS	COMMERCIAL	CONSUMER	CONSUMER AND COMMERCIAL	NKRA	CBI	TOTAL
None						

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

PHBS	CHILDREN'S PRODUCT USE	NKRA	OTHER USE	TOTAL
None				

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

H.11 TOXIC RELEASE INVENTORY REPORTS

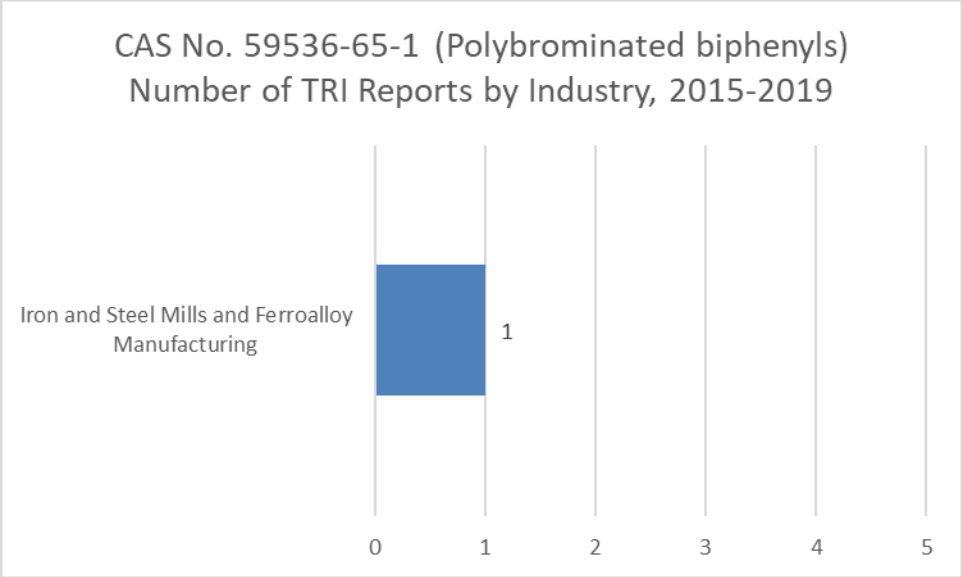
TRI-REPORTABLE CHEMICALS	
59536-65-1	Polybrominated biphenyls (PBB)

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TOTAL PRODUCTION-RELATED WASTE REPORTED							
PHBS		2015	2016	2017	2018	2019	GRAND TOTAL
59536-65-1	No. of Reports					1	1
	Pounds of waste managed					1,449	1,449

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TRI REPORTS BY INDUSTRY



Source: U.S. EPA, Toxics Release Inventory (2015-2019).

H.12 HIGH PRIORITY CHEMICALS DATA SYSTEM REPORTS

NUMBER OF REPORTS BY YEAR											
PHBS		2012	2013	2014	2015	2016	2017	2018	2019	2020[1]	TOTAL
None	Total										
	FR										
	Conc>0.1%										

[1] Partial year reporting.
Source: Interstate Chemicals Clearinghouse (2021).

H.13 PATENT COUNTS FROM PUBCHEM

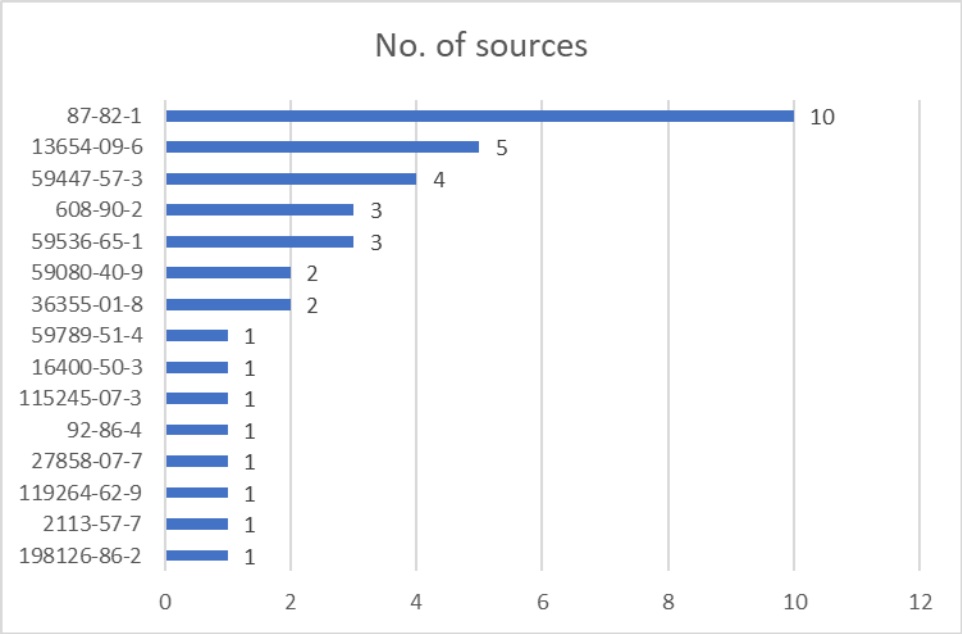
		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
87-82-1	6905	643	4,422	5,605	**10,670**	288	975	1,677	**2,940**	183	558	741	**1,482**
92-66-0	7101	134	1,484	5,495	**7,113**	3	1	9	**13**	3	0	8	**11**
92-86-4	7110	53	931	3,498	**4,482**	8	8	57	**73**	6	2	10	**18**
608-90-2	11854	47	270	572	**889**	9	64	168	**241**	6	47	66	**119**
626-39-1	12279	65	780	3,091	**3,936**	2	17	57	**76**	2	12	33	**47**
636-28-2	12486	21	102	332	**455**	0	0	10	**10**	0	0	10	**10**
2113-57-7	16449	16	780	1,815	**2,611**	0	1	1	**2**	0	1	1	**2**
13654-09-6	26164	234	868	1,414	**2,516**	121	186	438	**745**	64	117	251	**432**
14957-65-4	84727	1	0	0	**1**	0	0	0	**0**	0	0	0	**0**
16400-50-3	635340	20	12	122	**154**	6	2	1	**9**	3	1	1	**5**
27858-07-7	3032840	254	563	685	**1,502**	121	228	323	**672**	48	133	210	**391**
31710-32-4	612068	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
36355-01-8	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
42429-88-9	21421351	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
42429-89-0	6451882	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
56890-89-2	92557	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
59080-37-4	591322	0	0	2	**2**	0	0	0	**0**	0	0	0	**0**
59080-39-6	181214	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
59080-40-9	42948	126	268	255	**649**	73	66	95	**234**	29	50	57	**136**
59080-41-0	154382	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
59447-57-3	101059	20	501	3,503	**4,024**	5	180	931	**1,116**	3	115	493	**611**
59536-65-1	158629	28	36	60	**124**	9	0	0	**9**	4	0	0	**4**
59789-51-4	3017156	2	84	305	**391**	0	21	10	**31**	0	17	7	**24**
60044-24-8	591320	0	0	1	**1**	0	0	0	**0**	0	0	0	**0**
60044-25-9	91669	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
60044-26-0	104942	0	0	14	**14**	0	0	0	**0**	0	0	0	**0**
67733-52-2	49972	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
67888-96-4	49996	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**

		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
67888-97-5	107888	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
67888-98-6	119124	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
67888-99-7	108023	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
67889-00-3	119294	8	98	121	**227**	2	46	65	**113**	1	32	47	**80**
69278-59-7	155277	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
69278-60-0	155278	0	1	0	**1**	0	1	0	**1**	0	0	0	**0**
69278-61-1	155279	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
69278-62-2	154397	0	7	11	**18**	0	6	7	**13**	0	5	4	**9**
69887-11-2	154402	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
77102-82-0	107953	0	0	10	**10**	0	0	2	**2**	0	0	0	**0**
79596-31-9	53471992	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
82865-89-2	154482	14	132	145	**291**	5	42	71	**118**	4	31	49	**84**
83929-69-5	3019500	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
84303-46-8	158628	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
84303-48-0	158630	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
115245-07-3	189283	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
119264-59-4	153894	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
119264-60-7	153895	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
119264-61-8	153896	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
119264-62-9	34004	1	14	35	**50**	0	10	8	**18**	0	9	6	**15**
119264-63-0	153897	0	1	4	**5**	0	0	0	**0**	0	0	0	**0**
198126-86-2	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**

Source: PubChem Patent Data (See Exhibit 2-1 in main report and on OFR_universe_wPCPy_10122021.xlsx, tab 'Patent Info by CID' in Supplemental Information)

H.14 PHBS CITED IN LITERATURE REVIEW

A literature search was conducted to identify sources with information about chemicals in this OFR class (see Chapter 3). PHBs are mentioned or referenced in 19 of the 187 sources reviewed.



In this section, the following OECD use codes for chemicals are listed according to the internationally harmonized functional, product and article use categories[18]:

- AC1a. Complex articles. Road Vehicles for passengers and goods. Examples: Cars, trucks, vans.
- AC5e. Fabrics, textiles, and apparel. Furniture & furnishings, including furniture coverings. Examples: Sofa cover, car seat cover, fabric chair, hammock.
- AC13e. Plastic articles (hard). Furniture & furnishings, including furniture coverings. Examples: Computer casing.
- AC13g. Plastic articles (hard). Other articles made of plastic that are not expected to routinely be in contact with people. Examples:
- AC14b. Plastic articles (soft). Toys intended for children's use (and child dedicated articles). Examples: Toys (dolls, car, animals).

H.14.1 87-82-1 HEXABROMOBENZENE

- This chemical was referenced in 10 sources

[18] Source: OECD (2017).

- Three sources mentioned product testing data, and three sources presented concentration data
    - New and secondhand toys: mean 0.000004 percent
    - E-waste: not detected; vehicles: not detected; construction materials: max 0.0001 percent; textiles: max 0.0001 percent.
    - Computer casing: 0.018 percent; cotton sound insulation: 0.0468 percent; decorative laminate: 0.0165 percent; car seat foam: 0.000076 percent; car seat fabric: 0.000013 percent; car seats composite: 0.000023 percent,
    - Dish clothes: 0.031ng per cloth
- Two sources cited use in consumer products (curtains; textiles and electronics)
- Three sources reported human or environmental exposure data
- OECD use codes for this chemical included AC5e.
- Multiple sources indicated this is a low production volume chemical (e.g., between 4 and 230 tonnes in the United States between 1986 and 1998)
- According to these sources, this chemical has been used in paper, plastic, electronic manufactured goods, polymers, textiles, and woods
- One source referenced end of life issues and two mentioned laws or regulations

H.14.2 13654-09-6 1,1'-BIPHENYL, 2,2',3,3',4,4',5,5',6,6'-DECABROMO-

- This chemical was referenced in five sources
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- Two sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- According to these sources, this chemical has been used in: typewriter, calculator and microfilm-reader housing; business machine housings; radio and TV parts, thermostats, shaver and hand tool housings; projector housings, movie equipment cases; miscellaneous small automotive parts; electrical-wire connectors, switch connectors, speaker grills; small parts for electrical applications, motor housings; components for industrial equipment
- One source mentioned use trends over time and two mentioned laws or regulations

H.14.3 59447-57-3 POLY(PENTABROMOBENZYL ACRYLATE)

- This chemical was referenced in four sources
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- OECD use codes for this chemical included AC1a
- According to these sources, this chemical has been used in: PA, PBT, and PP resins in automotive and electronic end uses
- One source mentioned use trends over time

H.14.4 608-90-2 BENZENE, PENTABROMO-

- This chemical was referenced in three sources

- Two sources mentioned product testing data, and two sources presented concentration data
    - New and secondhand toys: mean 0.000016 percent
    - 553 products including upholstered furniture, electrical and electronic equipment, and selected plastic products in homes and offices: detected in 50 percent of samples but no concentrations given
- One source cited use in consumer/children's products (new and secondhand children's toys)
- No sources reported human or environmental exposure data
- OECD use codes for this chemical included AC13e
- According to these sources, this chemical has been used in: furniture and electronics
- One source mentioned laws or regulations

H.14.5 59536-65-1 POLYBROMINATED BIPHENYLS (PBB)

- This chemical was referenced in three sources
- One source mentioned product testing data, and one source presented concentration data
    - A selection of baby-related products (baby textiles, soft non-PVC toys, baby mattresses, diaper-changing mats, feeding chairs, baths, aprons): not detected
- One source cited use in consumer products (polystyrene foam)
- No sources reported human or environmental exposure data
- OECD use codes for this chemical included AC13g, AC14b
- According to these sources, this chemical has been used: polystyrene foam
- No sources discussed this chemical in the context of supply chain issues, use trends, substitutes/alternatives, end of life issues, or laws/regulations

H.14.6 59080-40-9 2,2',4,4',5,5'-HEXABROMOBIPHENYL

- This chemical was referenced in two sources
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- One source reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No specific uses for this chemical were identified
- One source mentioned this chemical in the context of laws or regulations

H.14.7 36355-01-8 HEXABROMOBIPHENYL

- This chemical was referenced in two sources
- No sources mentioned product testing data
- No sources cited use in consumer or children's products were identified
- One source reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- According to these sources, this chemical has been used: typewriter, calculator and microfilm-reader housing; business machine housings; radio and TV parts, thermostats, shaver and hand tool housings; projector housings, movie equipment cases; miscellaneous small automotive parts; electrical-wire connectors, switch connectors, speaker grills; small parts for electrical applications, motor housings; components for industrial equipment

- One (older) source indicated this had been a high production volume chemical
- No sources discussed this chemical in the context of supply chain issues, use trends, substitutes/alternatives, end of life issues, or laws/regulations

H.14.8 59789-51-4 1H-PYRROLE-2,5-DIONE, 1-(2,4,6-TRIBROMOPHENYL)-

- This chemical was referenced in one source
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided information on uses for this chemical
- One source mentioned use trends over time

H.14.9 16400-50-3 1,1'-BIPHENYL, 3,3',5,5'-TETRABROMO-

- This chemical was referenced in one source
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided information on uses for this chemical
- One source mentioned laws and regulations

H.14.10 115245-07-3 1,1'-BIPHENYL, 2,4,5-TRIBROMO-

- This chemical was referenced in one source
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided information on uses for this chemical
- One source mentioned laws and regulations

H.14.11 92-86-4 1,1'-BIPHENYL, 4,4'-DIBROMO-

- This chemical was referenced in one source
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided information on uses for this chemical
- One source mentioned laws and regulations

H.14.12 27858-07-7 OCTABROMOBIPHENYL

- This chemical was referenced in one source
- No sources mentioned product testing data

- No sources cited use in consumer or children's products
- One source reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- One (older) source indicated the following uses for this chemical: typewriter, calculator and microfilm-reader housing; business machine housings; radio and TV parts, thermostats, shaver and hand tool housings; projector housings, movie equipment cases; miscellaneous small automotive parts; electrical-wire connectors, switch connectors, speaker grills; small parts for electrical applications, motor housings; components for industrial equipment
- One source mentioned laws and regulations

H.14.13 119264-62-9 2,2',3,3',4,4',5,6,6'-NONABROMO-1,1'-BIPHENYL

- This chemical was referenced in one source
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- One source reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- One (older) source indicated the following uses for this chemical: typewriter, calculator and microfilm-reader housing; business machine housings; radio and TV parts, thermostats, shaver and hand tool housings; projector housings, movie equipment cases; miscellaneous small automotive parts; electrical-wire connectors, switch connectors, speaker grills; small parts for electrical applications, motor housings; components for industrial equipment
- One source mentioned laws and regulations

H.14.14 2113-57-7 3-BROMOBIPHENYL

- This chemical was referenced in one source
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided information on uses for this chemical
- One source mentioned laws and regulations

H.14.15 198126-86-2 TETRABROMO TRICHLOROMETHYL BENZENE

- This chemical was referenced in one source
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided information on uses for this chemical
- One source mentioned use trends over time

H.15 LITERATURE SOURCES USED

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APPENDIX I | POLYHALOGENATED BISPHENOL ALIPHATICS AND FUNCTIONALIZED

I.1 SUMMARY BY CHEMICAL – PHBAFS

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
ALL	**Across 14 PHBAFs**		**6**	**10**	**12**	**NA**	**14**	**13**	**NA**	**NA**	**7**
21850-44-2	Tetrabromobisphenol A-bis(2,3-dibromopropyl ether)	TBBPA-DBPE	1	1	13	high	0.9862	3,058	81%	80%	3
25327-89-3	Tetrabromobisphenol A diallyl ether	TBBPA-BAE	2	1	8	high	0.9558	1,619	81%	86%	2
29426-78-6	4,4'(propane2,2diyl)bis(2bromophenol)		0	0		low	0.6083	9,486	77%	74%	
3072-84-2	2,2'-[(1-Methylethylidene)bis[(2,6-dibromo-4,1-phenylene)oxymethylene]]bis[oxirane]	TBBPA-BGE	1	1	2	high	0.9384	151	68%	88%	1
33798-02-6	Phenol, 4,4'-(1-methylethylidene)bis[2,6-dibromo-, 1,1'-diacetate	TBBPA-BOAC	0	1	1	high	0.8924	9	0%	0%	
37419-42-4	3,3',5,5'-Tetrabromobisphenol A bispropionate	TBBPA-BP	0	0	1	high	0.843	0			
37853-61-5	Tetrabromobisphenol A dimethyl ether	TBBPA-BME	1	1	3	high	0.9465	56	66%	38%	1
4162-45-2	Tetrabromobisphenol A bis(2-hydroxyethyl) ether	TBBPA-BHEE	2	1	3	high	0.9347	535	64%	56%	2
55205-38-4	(Propane-2,2-diyl)bis(2,6-dibromo-4,1-phenylene) diprop-2-enoate	TBBPS-BA	0	0	1	high	0.9433	1,637	78%	45%	
66710-97-2	Bis(p-acryloxyethoxy)tetrabromobisphenol A	TBBPA-BHEEBA	0	2	1	high	0.9573	74	28%	0%	
70156-79-5	1,1'-sulfonylbis(3,5-dibromo-4-methoxybenzene)	TBBPS-BME	0	0	1	high	0.74	4	75%	100%	
79-94-7	3,3',5,5'-Tetrabromobisphenol A	TBBPA	4.5	1	42	high	0.882	81,973	64%	66%	11
79-95-8	2,2',6,6'-Tetrachlorobisphenol A		0	2		high	0.882	25,180	58%	64%	1
97416-84-7	1,1'-(Isopropylidene)bis(3,5-dibromo-4-(2,3-dibromo-2-methylpropoxy)benzene)		0	1	1	high	0.9537	31	84%	90%	

I.1.1 OVERVIEW

There are 14 substances in the OFR class "polyhalogenated bisphenol aliphatics and functionalized" (PHBAFs), with key attributes described in the Summary by Chemical table (For field definitions and color scheme, see Guide to Summary Tables, Appendix B.1). Of these, six are active TSCA Inventory substances and another three are inactive. One additional substance (not on the TSCA Inventory) appears on the EU Reach and Japanese CSCL list. The remaining substances do not appear on any of the inventories we reviewed.

During our literature search, we found that the six PHBAFs chemicals found on the TSCA active inventory are referenced in the literature at length and there are also citations for two of the three inactive PHBAF chemicals. In addition, data for four PHBAFs chemicals that are not on the TSCA inventory were identified in the literature. Patent data from PubChem reported information on 13 PHBAF chemicals.

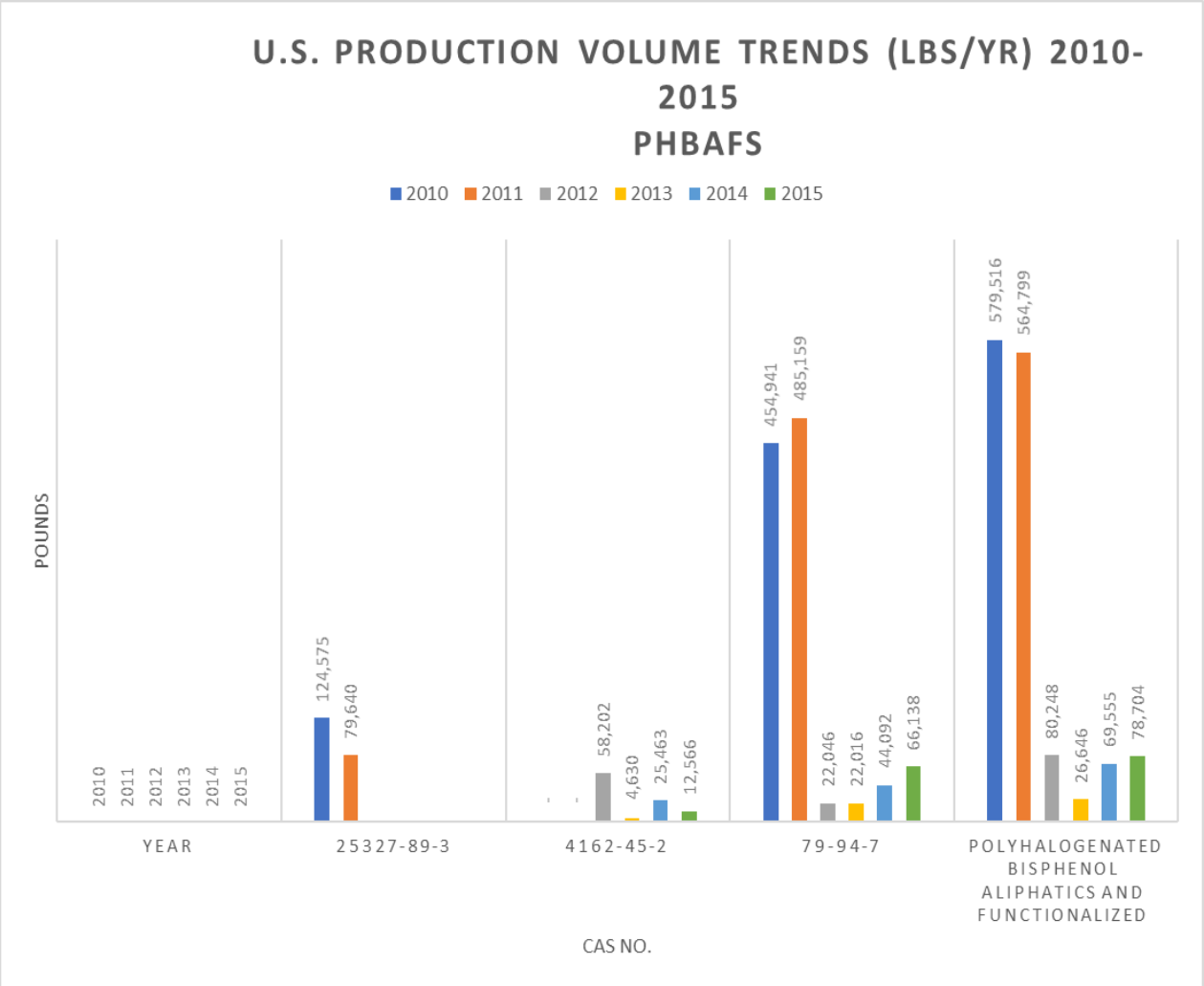
I.1.2 INDUSTRY PRODUCTION AND USE

Most of the available information from EPA focuses on five of the 14 substances included in this class. The substance for which there is the most information is TBBPA (CAS No. 79-94-7), which has many uses and appears to be used in the largest volume.

For the most recent year available from EPA, 2015, U.S. industry reported manufacturing and importing PHBAFs into the United States. Specifically, industry submitted one report of manufacturing activity for one chemical (CAS No. 79-94-7), five reports of importing activity (CAS Nos. 79-94-7 [3 reports], 4162-45-2 [1 report], 25327-89-3[1 report]), one report of manufacturing *and* importing activity (CAS No. 79-94-7), and four additional reports where the activity was not specified or was claimed as CBI (CAS Nos. 79-94-7 [3 reports] and 21850-44-2 [1 report]). Eight of the 11 reports received in 2015 were for TBBPA (CAS No. 79-94-7).

TBBPA (CAS No. 79-94-7) is considered a medium to high production volume chemical.

Total reported production volume (manufacturing plus importing) in 2015 included approximately 66,000 pounds for CAS No. 79-94-7 and 12,500 pounds for CAS No. 4162-45-2. Production volume (PV) trend data for 2010-2015 indicates the combined PV for reported substances averaged 233,245 pounds per year. The PV for CAS No. 79-94-7 dropped sharply between 2011 and 2012, but has increased slightly since then, going from 22,000 pounds in 2012 and 2013 to 66,000 pounds in 2015.



Source: U.S. EPA, CDR (2016).

Chemical Data Reporting (CDR) data from EPA indicate that reportable PVs of PHBAF chemicals have declined but that these chemicals have been produced in large quantities, each year, for over a decade. Industry identified 18 processing and use activities for PHBAF substances in 2015, of which 13 involved processing or use as a flame retardant. From industry reporting to EPA, uses as a flame retardant included:

- Electrical equipment, appliance, and component manufacturing;
- Plastic product manufacturing;
- Plastic material and resin manufacturing;
- Computer and electrical product manufacturing; and
- Textile, apparel, and leather manufacturing.

Four reports (all for CAS No. 74-94-7) identified either a consumer or consumer/commercial use and two reports (again, for CAS No. 74-94-7) identified a children's product use. All these uses were in *electrical*

and electronic products. This contrasts with product testing data found in the literature search and with reporting from the HPCDS, which indicate TBBPA is used in variety of consumer and children's products. Gaps in information within the supply chain make it difficult for industry to know or reasonably ascertain if hazardous chemicals are or will be used in consumer or children's products. Industry indicated that for CAS No. 4162-45-2, consumer product use was not known or reasonably ascertainable.

Over the period 2015-2019, industry has submitted approximately 50 reports each year under the Toxics Release Inventory (TRI) for CAS No. 74-94-7, the most of any TRI-listed OFR chemical. The use classifications for the chemical has included:

- 3.2A: P102. Processing as a reactant (Raw materials).
- 3.2A: P199. Processing as a reactant (Other).
- 3.2B: P201. Processing as a formulation component (Additives).
- 3.2B: P203. Processing as a formulation component (Reaction diluents).
- 3.2B: P204. Processing as a formulation component (Initiators).
- 3.2B: P210. Processing as a formulation component (Flame retardants).
- 3.2B: P299. Processing as a formulation component (Other).
- 3.3A: Z199. Otherwise use as a chemical processing aid (Other).
- 3.3B: Z299. Otherwise use as a manufacturing aid (Other).
- 3.3C: Z306. Otherwise use: ancillary or other use (Waste treatment).
- 3.3C: Z399. Otherwise use: ancillary or other use (Other).

TRI reports indicate the waste volume managed for this chemical declined between 2015 and 2017, but then increased in 2018 and 2019. Excluding recycling, the volume of waste managed was 238,000 pounds in 2019. Industries accounting for the most reports include:

- Plastics Material and Resin Manufacturing (49 reports)
- Hazardous Waste Treatment and Disposal (31 reports)
- Custom Compounding of Purchased Resins (29 reports)
- All Other Plastics Product Manufacturing (28 reports)
- Other Aircraft Part and Auxiliary Equipment Manufacturing (26 reports)
- Aircraft Manufacturing (20 reports)
- Adhesive Manufacturing (19 reports)

I.1.3 USE IN CONSUMER AND CHILDREN'S PRODUCTS

The states of Washington and Oregon require industry to report on chemicals of concern in products intended for use by children that are sold in those states. The reporting tool used by Washington and Oregon is known as the High Priority Chemicals Data System (HPCDS). According to data available from the HPCDS, manufacturers report the use of TBBPA in children's products.

In 2019, Tetrabromobisphenol A (CAS No. 79-94-7) was one of the most reported OFR chemicals of concern in children's products, receiving 40 reports of use by industry.

Over the period 2013-2020, a total of 246 reports were submitted for Tetrabromobisphenol A (CAS No. 79-94-7), commonly referred to as TBBPA; 84 of these indicated the chemical function in each product was "flame retardant" and 12 of these reported the concentration in the final product exceeded 0.1 percent. In fact, in all 12 reports the concentration exceeds 10,000 ppm (1.0 percent). Children's products falling into this group included toy vehicles, baby feeding products, baby play pens, baby swings, and other baby products like baby carriers and baby car/booster seats. Comparing information from the HPCDS to child product use reporting under TSCA reports suggests that TBBPA (CAS No. 79-94-7) is used in a broader array of imported products compared to those manufactured in the United States.

PHBAFs have been cited in 47 of the 187 literature sources reviewed. Among the 12 PHBAFs cited, chemicals appearing in the largest number of these sources include: CAS No. 79-94-7 (42 sources), CAS No. 21850-44-2 (12 sources) and CAS No. 25327-8903 (10 sources). Several sources report the results of product testing, and these indicate PHBAFs have been found in a variety of consumer and/or children's products in widely varying concentrations, such as:

- CAS No. 21850-44-2: Hard plastic toys, 0 to 21.3 percent concentration
- CAS No. 21850-44-2: Soft plastic toys, 0 to 3.7 percent concentration

Uses for PHBAFs identified through the literature review (as described in Chapter 3) include:

CAS No. 79-94-7: durable infant or toddler products, toys, childcare article or other children's product other than car seats, mattress and mattress pads, plastic products, all electric/electronic equipment, E-waste, adaptors, heat sealer, powerboard, LCD TVs, TVs, plastic ornament, electrical adaptor, television, decorative item, router, plastics, resin, food contact articles, textiles, curtains, carpets, printers, tv housings, expanded polystyrene, extruded polystyrene foam, construction materials, paper.

CAS No. 4162-45-2. engineering polymers, epoxy resins, thermoset and thermoplastic polyesters, polyurethane, laminates for electronic circuit boards, and adhesives and coatings.

CAS No. 25327-89-3: expanded polystyrene and polystyrene foams, adhesives pipes, water barriers, kitchen hoods, and electronics, curtains, electronic equipment (TV, audio, video) and PC monitors, polyolefin and styrenic resins, high impact polystyrene.

CAS No. 4162-45-2: engineering polymers, epoxy resins, thermoset and thermoplastic polyesters, polyurethane, laminates for electronic circuit boards, and adhesives and coatings.

I.2 PHBAFS ON NATIONAL AND INTERNATIONAL INVENTORIES AND REGISTRIES

Chemicals in class: 14

- 6 active on TSCA Inventory (recently manufactured/imported in U.S.)[19]
- 3 inactive on TSCA Inventory (no longer manufactured/imported in U.S.)
- 5 not on TSCA Inventory (never manufactured/imported in U.S.)

PHBAFS ON THE TSCA ACTIVE INVENTORY	
79-94-7	3,3',5,5'-Tetrabromobisphenol A
3072-84-2	2,2'-[(1-Methylethylidene)bis[(2,6-dibromo-4,1-phenylene)oxymethylene]]bis[oxirane]
4162-45-2	Tetrabromobisphenol A bis(2-hydroxyethyl) ether
21850-44-2	Tetrabromobisphenol A-bis(2,3-dibromopropyl ether)
25327-89-3	Tetrabromobisphenol A diallyl ether
37853-61-5	Tetrabromobisphenol A dimethyl ether
PHBAFS ON THE TSCA INACTIVE INVENTORY	
79-95-8	Phenol, 4,4'-(1-methylethylidene)bis[2,6-dichloro-
33798-02-6	Phenol, 4,4'-(1-methylethylidene)bis[2,6-dibromo-, 1,1'-diacetate
66710-97-2	2-Propenoic acid, 1,1'-[(1-methylethylidene)bis[(2,6-dibromo-4,1-phenylene)oxy-2,1-ethanediyl]] ester

OTHER PHBAFS ON INTERNATIONAL REGISTRIES		
97416-84-7	1,1'-(Isopropylidene)bis(3,5-dibromo-4-(2,3-dibromo-2-methylpropoxy)benzene)	Japan CSCL

I.3 U.S. MANUFACTURING AND IMPORTING ACTIVITY, 2015

NUMBER OF REPORTS BY ACTIVITY TYPE						
PHBAFS	MANUFACTURE	IMPORT	BOTH MANUFACTURE AND IMPORT	NOT SPECIFIED	CBI	TOTAL
21850-44-2					1	1
25327-89-3		1				1
4162-45-2		1				1
79-94-7	1	3	1	1	2	8
Total	**1**	**5**	**1**	**1**	**3**	**11**

Source: U.S. EPA, CDR (2016).

[19] "Active" indicates that U.S. manufacturing or importing activity has been reported since June 2006.

I.4 U.S. MANUFACTURING AND IMPORTING VOLUMES, 2015

REPORTED VOLUMES BY ACTIVITY TYPE					
PHBAFS	MANUFACTURE	IMPORT	PRODUCTION VOLUME (MANUFACTURE + IMPORT)	USED	EXPORTED
21850-44-2	-	-	-	-	-
25327-89-3	-	-	-	-	-
4162-45-2	-	12,566	12,566	-	-
79-94-7	-	66,138	66,138	-	-
Total	**-**	**78,704**	**78,704**	**-**	**-**

"-" = data CBI or otherwise not disclosed
Source: U.S. EPA, CDR (2016).

I.5 U.S. PRODUCTION VOLUME TRENDS, 2012-2015

PHBAFS	PV 2015	PV 2014	PV 2013	PV 2012
21850-44-2	-	-	-	-
25327-89-3	-	-	-	-
4162-45-2	12,566	25,463	4,630	58,202
79-94-7	66,138	44,092	22,016	22,046
Total	**78,704**	**69,555**	**26,646**	**80,248**

"-" = data CBI or otherwise not disclosed
PV = manufacturing plus importing
Source: U.S. EPA, CDR (2016).

I.6 TYPE OF PROCESSING OR USE REPORTS, 2015

NUMBER OF REPORTS								
PHBAFS	Processing as a Reactant	Processing—Incorporation Into Article	Processing—Incorporation Into Formulation, Mixture, or Reaction Product	Processing—Repackaging	Use—Non-Incorporative Activities	CBI	NKRA[A]	Grand Total
21850-44-2			1					1
25327-89-3		1	1					2
4162-45-2		1						1
79-94-7	3	3	8					14
Total	**3**	**5**	**10**					**18**

[a]NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

I.7 INDUSTRIAL USE REPORTS, 2015

NUMBER OF REPORTS																							
PHBAFS	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA[A]	Grand Total
21850-44-2																	1						1
25327-89-3																1	1						2
4162-45-2																				1			1
79-94-7				2	1			4			1					3	2				1		14
Totals				**2**	**1**			**4**			**1**					**4**	**4**			**1**	**1**		**18**
USED AS FLAME RETARDANT																							
21850-44-2																	1						1
25327-89-3																1	1						2
4162-45-2																				1			1
79-94-7					1			4								2	2						9
Totals					**1**			**4**								**3**	**4**			**1**			**13**

[A]NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

I.8 INDUSTRIAL FUNCTION REPORTS, 2015

NUMBER OF REPORTS															
PHBAFS	Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Other	Paint Additives and Coating Additives Not Described by Other Categories	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	CBI	NKRA[A]	Grand Total
21850-44-2				1											1
25327-89-3				2											2
4162-45-2				1											1
79-94-7				9	1	3					1				14
Total				**13**	**1**	**3**					**1**				**18**

[a]NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

I.9 INDUSTRIAL SECTOR REPORTS, 2015

NUMBER OF REPORTS: POLYHALOGENATED BISPHENOL ALIPHATICS AND FUNCTIONALIZED																							
PHBAF	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
ALL INDUSTRIAL FUNCTIONS																							
Total				2	1			4			1					4	4			1	1			18
21850-44-2																	1							1
25327-89-3																1	1							2
4162-45-2																				1				1
79-94-7				2	1			4			1					3	2				1			14
USED AS FLAME RETARDANT																							
Total					1			4								3	4			1				13
21850-44-2																	1							1
25327-89-3																1	1							2
4162-45-2																				1				1
79-94-7					1			4								2	2							9

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

I.10 CONSUMER AND CHILDREN'S PRODUCT USE REPORTS, 2015

NUMBER OF REPORTS						
PHBAFS	COMMERCIAL	CONSUMER	CONSUMER AND COMMERCIAL	NKRA[A]	CBI	TOTAL
21850-44-2	1					1
4162-45-2	1					1
79-94-7	2		4			6
Totals	**4**		**4**			**8**

[a]NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

Reports for 79-94-7 in the "Consumer and Commercial" use group were for use in the following product categories:

- Electrical and electronic products

PHBAFS	CHILDREN'S PRODUCT USE	NKRA[A]	OTHER USE	TOTAL
21850-44-2			1	1
4162-45-2		1		1
79-94-7	2		4	6
Totals	**2**	**1**	**5**	**8**

[a]NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

Reports for 79-94-7 in the "Children's Product" use group were for use in the following product categories:

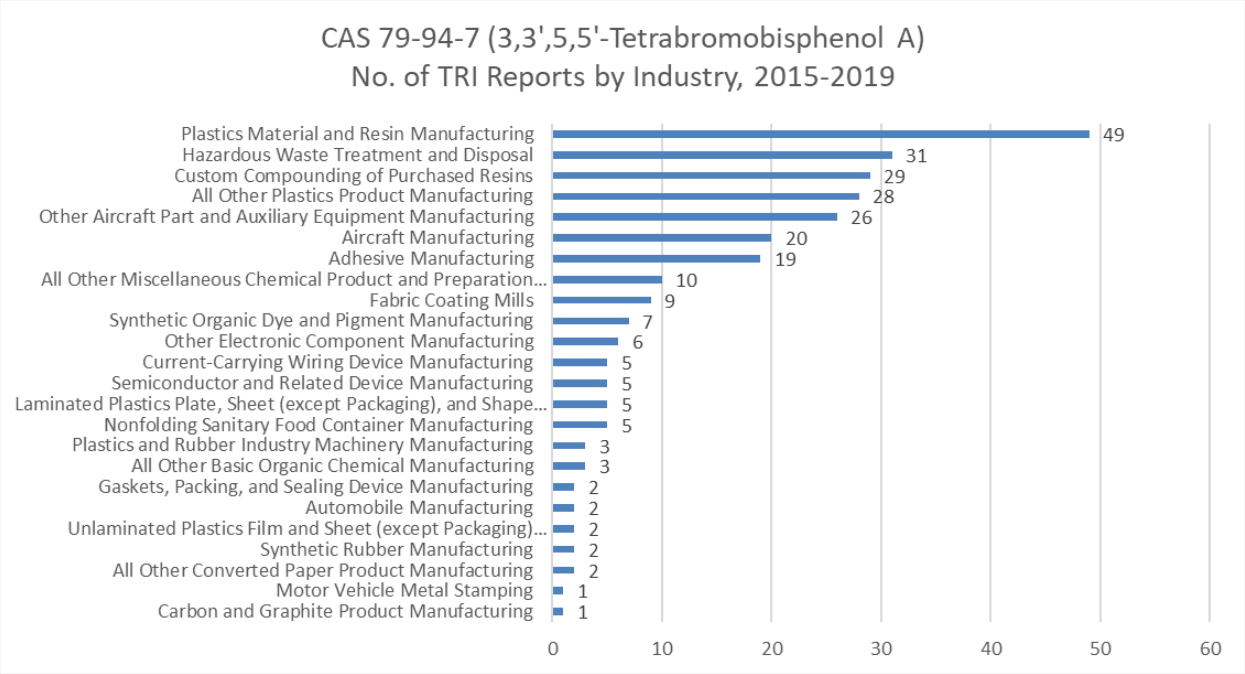
- Electrical and electronic products.

I.11 TOXIC RELEASE INVENTORY REPORTS

TRI-REPORTABLE CHEMICALS	
79-94-7	3,3',5,5'-Tetrabromobisphenol A

TOTAL PRODUCTION-RELATED WASTE REPORTED							
PHBAFS		2015	2016	2017	2018	2019	GRAND TOTAL
79-94-7	No. of Reports	56	58	54	50	54	272
	Pounds of waste managed	294,082	208,899	133,435	141,977	2,452,031	3,230,424

TRI REPORTS BY INDUSTRY



Source: U.S. EPA, Toxics Release Inventory (2015-2019).

I.12 HIGH PRIORITY CHEMICALS DATA SYSTEM (HPCDS) REPORTS

NUMBER OF REPORTS BY YEAR											
PHBAFS		2012	2013	2014	2015	2016	2017	2018	2019	2020[1]	TOTAL
79-94-7	Total		25	28	13	40	71	20	40	9	246
	FR		13	1	3	1	61	3	2		84
	Conc>0.1%		10					1	1		12

[1] Partial year reporting.
Source: Interstate Chemicals Clearinghouse (2021).

Reported uses include: toy vehicles, baby feeding accessories, baby play pens, baby swings, baby carrier, baby car/booster seat.

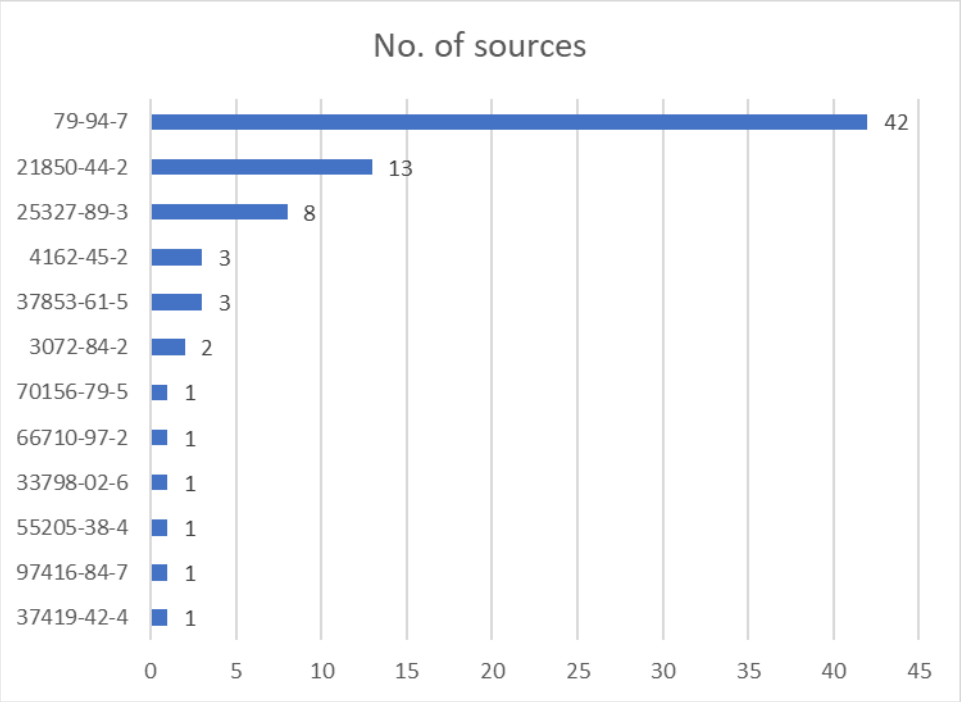
I.13 PATENT COUNTS FROM PUBCHEM

		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
79-94-7	6618	2,217	27,454	52,302	**81,973**	499	3,881	8,361	**12,741**	259	2,348	4,238	**6,845**
79-95-8	6619	1,274	9,403	14,503	**25,180**	186	745	1,636	**2,567**	98	516	832	**1,446**
3072-84-2	62250	7	41	103	**151**	0	4	28	**32**	0	1	24	**25**
4162-45-2	20113	62	130	343	**535**	33	9	54	**96**	23	6	20	**49**
21850-44-2	62753	23	552	2,483	**3,058**	13	273	1,170	**1,456**	8	185	657	**850**
25327-89-3	61972	11	293	1,315	**1,619**	8	74	498	**580**	6	49	226	**281**
29426-78-6	656687	142	2,067	7,277	**9,486**	55	243	855	**1,153**	14	200	454	**668**
33798-02-6	118551	2	7	0	**9**	2	0	0	**2**	2	0	0	**2**
37419-42-4	3341665	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
37853-61-5	37841	3	16	37	**56**	3	10	8	**21**	3	7	6	**16**
55205-38-4	62093	1	351	1,285	**1,637**	0	18	15	**33**	0	10	5	**15**
66710-97-2	105380	2	51	21	**74**	1	8	0	**9**	0	0	0	**0**
70156-79-5	2302732	1	0	3	**4**	0	0	3	**3**	0	0	3	**3**
97416-84-7	22345068	0	5	26	**31**	0	2	19	**21**	0	0	9	**9**

Source: PubChem Patent Data (See Exhibit 2-1 in main report and on OFR_universe_wPCPy_10122021.xlsx, tab 'Patent Info by CID' in Supplemental Information)

I.14 PHBAFS CITED IN LITERATURE REVIEW

A literature search was conducted to identify sources with information about chemicals in this OFR class (see Chapter 3). PHBAFs are mentioned or referenced in 47 of the 187 sources reviewed.[20]



In this section, the following OECD use codes for chemicals are listed according to the internationally harmonized functional, product and article use categories published in May 2017:[21]

- AC2a. Complex articles. Machinery, mechanical appliances, electrical/electronic articles. Examples: Refrigerators, washing machines, vacuum cleaners, computers, telephones, drills, saws, smoke detectors, thermostats, radiators.
- AC3. Complex articles. Electrical batteries and accumulators. Examples: Batteries.
- AC5e. Fabrics, textiles, and apparel. Furniture & furnishings, including furniture coverings. Examples: Sofa cover, car seat cover, fabric chair, hammock.
- AC13a. Plastic articles (hard). Construction and building materials covering large surface areas. Examples: Outdoor play equipment, insulation (reacted off-site-, structural insulation panels), insulation applied on-site (spray polyurethane foam), flooring.
- AC13b. Plastic articles (hard). Toys intended for children's use (and child dedicated articles). Examples: Toys (dolls, car, animals, teething rings).

[20] See "Literature Sources Used" section below.

[21] See (https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2017)14&doclanguage=en

- AC13e. Plastic articles (hard). Furniture & furnishings, including furniture coverings. Examples: Computer casing.
- AC13f. Plastic articles (hard). Other articles with routine direct contact during normal use. Examples: Handles, pencils, handheld device casing.
- AC14a. Plastic articles (soft). Construction and building materials covering large surface areas. Examples: Blown or sprayed building insulation.

I.14.1 79-94-7 - 3,3',5,5'-TETRABROMOBISPHENOL A

- This chemical was cited in 42 sources
- Sixteen sources cited product testing data, while 15 presented concentration data
    - Various plastic items: 0.1 to 7 percent
    - TV: 7 percent
    - Thermal cup lids: 2.6 to 30 percent
- Seven sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC3, AC5e, AC13b, AC13e, and AC13f
- Sources cited production ranging from 150,000 pounds in 2004 to 120 million pounds in 2011. Four sources categorized this chemical as medium production (100,000-1 million pounds per year) and three categorized it as high production (>1 million pounds per year)
- These sources indicate the chemical has been used in durable infant or toddler products, toys, childcare article or other children's product other than car seats, mattress and mattress pads, plastic products, all electric/electronic equipment, adaptors, heat sealer, powerboard, LCD TVs, TVs, plastic ornament, electrical adaptor, television, decorative item, router, plastics, resin, food contact articles, textiles, curtains, carpets, printers, tv housings, expanded PS (EPS), extruded PS foam (XPS), extruded PS related to food, laboratory, aquaculture, construction, paper, and phenolic.
- One source cited this chemical in the context of supply chain issues, three cited use trends over time, two discussed alternatives, four summarized end of life issues, and seven cited laws or regulations related to flame retardants

I.14.2 21850-44-2 - TETRABROMOBISPHENOL A-BIS(2,3-DIBROMOPROPYL ETHER)

- This chemical was cited in 12 sources
- Two sources cited product testing data, while one presented concentration data
    - Hard plastic toys: 0 to 21.3 percent
    - Soft plastic toys: 0 to 3.7 percent
- Three sources reported human or environmental exposure data
- One source discussed potential alternatives to this chemical
- OECD use codes for this chemical included AC2a, Ac2b, AC5b, AC5e, and AC13e
- Sources estimated EU production at 1,000 to 10,000 tonnes per year, while China produces around 3,000 tonnes per year
- According to these sources, the chemical is used in expanded polystyrene and polystyrene foams, pipes, water barriers, kitchen hoods, and electronics, curtains, polyolefin and styrenic resins, high impact polystyrene, in electronic equipment (TV, audio, video) and PC monitors

I.14.3 25327-89-3 - TETRABROMOBISPHENOL A DIALLYL ETHER

- This chemical was cited in 10 sources
- Two sources cited product testing data, while one presented concentration data (<0.1 percent)
- Two sources reported human or environmental exposure data and one source cited other exposure values
- OECD use codes for this chemical included AC13a, AC13b, AC13e, AC14a
- The chemical is reportedly produced at 1 to 10 tonnes per year in the EU
- According to these sources, this chemical is used in expanded polystyrene and polystyrene foams, adhesives, PS foams, and curtains
- Consumption of this chemical changed between 2003 and 2016

I.14.4 4162-45-2 - TETRABROMOBISPHENOL A BIS(2-HYDROXYETHYL) ETHER

- This chemical was cited in four sources
- One source reported human or environmental exposure and other exposure values
- OECD use codes for this chemical included AC13e
- The chemical is used in engineering polymers, epoxy resins, thermoset and thermoplastic polyesters, polyurethane, laminates for electronic circuit boards, and adhesives and coatings

I.14.5 3072-84-2 - 2,2'-[(1-METHYLETHYLIDENE)BIS[(2,6-DIBROMO-4,1-PHENYLENE)OXYMETHYLENE]]BIS[OXIRANE]

- This chemical was cited in three sources
- Two sources from the EU placed production in the range of 100-1,000 tonnes per year.
- The chemical is "recommended" for XPS, HIPS, and polyolefins
- OECD use codes for this chemical included AC13e

I.14.6 37853-61-5 - TETRABROMOBISPHENOL A DIMETHYL ETHER

- This chemical was cited in three sources
- OECD use codes for this chemical included AC13e
- The consumption of the chemical changed between 2003 and 2016 in the EU

I.14.7 97416-84-7 - 1,1'-(ISOPROPYLIDENE)BIS(3,5-DIBROMO-4-(2,3-DIBROMO-2-METHYLPROPOXY)BENZENE)

- This chemical was cited in two sources
- This chemical is "recommended" for EPS, XPS, ABS, as well as polyurethane
- The chemical was found in polyurethane and soft PVC at 15%

I.14.8 33798-02-6 - PHENOL, 4,4'-(1-METHYLETHYLIDENE)BIS[2,6-DIBROMO-, 1,1'-DIACETATE

- This chemical was cited in one source
- No other information was collected for this chemical

I.14.9 37419-42-4 - 3,3',5,5'-TETRABROMOBISPHENOL A BISPROPIONATE

- This chemical was cited in one source

- No other information was collected for this chemical

I.14.10 55205-38-4 - (PROPANE-2,2-DIYL)BIS(2,6-DIBROMO-4,1-PHENYLENE) DIPROP-2-ENOATE

- This chemical was cited in one source
- No other information was collected for this chemical

I.14.11 66710-97-2 - BIS(P-ACRYLOXYETHOXY)TETRABROMOBISPHENOL A

- This chemical was cited in one source
- No other information was collected for this chemical
- 70156-79-5 - 1,1'-sulfonylbis(3,5-dibromo-4-methoxybenzene)
- This chemical was cited in one source
- No other information was collected for this chemical

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APPENDIX J | POLYHALOGENATED CARBOCYCLES

J.1 SUMMARY BY CHEMICAL – PHCCS

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
ALL	**Across all 19 PHCCs (21 with mixed class)**		**7**	**14**	**8**	**NA**	**19**	**16**	**NA**	**NA**	**8**
115-27-5	Chlorendic anhydride	HCBCH-DCAnh	2	1		high	0.9616	4,973	66%	54%	1
115-28-6	Chlorendic acid	HCBCH-DCA	1	1	1	high	0.5594	11,661	63%	66%	3
13560-89-9	Dechlorane Plus	DDC-CO	2	1	7	high	0.9294	2,077	72%	71%	4
13560-90-2	4,5,6,7,13,14,15,16,19,19,20,20Dodecachloroheptacyclo[9.6.1.1~4,7~.1~13,16~.0~2,10~.0~3,8~.0~12,17~]icosa5,14diene (nonpreferred name)		0	0		low	0.9246	1	0%		
13560-91-3	1,2,3,4,5,6,7,8,10,10,11,11-Dodecachloro-4,4a,4b,5,8,8a,9,9a-octahydro-1H-1,4:5,8-dimethanofluorene		0	0		low	0.9294	0			
13560-92-4	1,4:5,8:9,10-Trimethanoanthracene, 1,2,3,4,5,6,7,8,12,12,13,13-dodecachloro-1,4,4a,5,8,8a,9,9a,10,10a-decahydro-	DDC-Ant	0	1		high	0.9246	0			
135821-03-3	DeChlordane Plus (syn isomer)		0	0	2	low	0.9294	3	100%		2
135821-74-8	anti-Dechlorane Plus		0	0	2	low	0.9294	272	36%		2
1770-80-5	Dibutyl chlorendate		1	1		med	0.8691	110	58%	60%	
1773-89-3	Chlorendate dimethyl		0	1		med	0.8619	3	67%		
18300-04-4	1,2-Dibromo-4,5,6,7,8,8-hexachloro-2,3,3a,4,7,7a-hexahydro-4,7-methano-1H-indene		0	1		med	0.9455	4	0%	0%	
2234-13-1	1,2,3,4,5,6,7,8-Octachloronaphthalene		2	1		low	0.8983	556	65%	0%	2
2385-85-5	Mirex		0	1	3	high	0.9142	11,381	79%	45%	4
31107-44-5	1,2,3,4,6,7,8,9,10,10,11,11-dodecachloro-1,4,4a,5a,6,9,9a,9b-octahydro-1,4:6,9-dimethanodibenzofuran	DDC-DBF	0	2		high	0.9469	2	0%	0%	

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
34571-16-9	1,2,3,4,7,7-Hexachloro-5-(pentabromophenyl)bicyclo[2.2.1]hept-2-ene	HCTBPH	1	1	2	high	0.9522	3	0%	0%	
40703-79-5	4,7-Methano-1H-isoindole-1,3(2H)-dione, 5,6-dibromohexahydro-2-phenyl-		0	1		med	0.947	2	0%	0%	
51936-55-1	7,8-Dibromo-1,2,3,4,11,11-hexachloro-1,4,4a,5,6,7,8,9,10,10a-decahydro-1,4-methanobenzocyclooctene	DBHCTD	0	1	5	high	0.9455	5	0%	0%	1
52907-07-0	N,N'-(Ethylene)bis[4,5-dibromohexahydro-3,6-methanophthalimide]		1	1	1	high	0.9464	127	77%	69%	
71245-27-7	Dechloran 604		0	0		med	0.9245	0			
855992-98-2	(rel)-(1R,2R,3S,4S)-1,2,3,9-tetrabromo-1,2,3,4-tetrahydro-1,4-methanonaphthalene		0	0		med	0.934	0			
855993-01-0	(rel)-(1R,2S,3S,4S)-1,2,3,9-tetrabromo-1,2,3,4-tetrahydro-1,4-methanonaphthalene		0	0		med	0.934	0			

Note: 855992-98-2 and 855993-01-0 are listed in both PHBzAFs and PHCCs

J.1.1 OVERVIEW

There are 19 substances in the OFR class "Polyhalogenated Carbocycles" (PHCCs), with key attributes described in the Summary by Chemical table (For field definitions and color scheme, see Guide to Summary Tables, Appendix B.1). Fourteen of these substances are reported on one or more chemical inventories we reviewed. Of these, seven are active TSCA Inventory[22] substances and another five are inactive. All seven active and one inactive TSCA Inventory substances appear on other (non-U.S.) inventories. An additional two substances not on the TSCA Inventory appear on non-U.S. inventories, in this case both Japan. The remaining nine substances do not appear on any inventories we reviewed. Two additional substances are cross-listed with PHBzAFs and do not appear on any inventories.

During our literature search, we found that while some of the PHCC chemicals found on the TSCA active inventory are referenced in the literature, others are not. In our literature search, we were able to collect data for four TSCA active chemicals, one TSCA inactive chemical, and one PHCC chemical identified on other inventories.

Patent data from PubChem reported information on 16 PHCC chemicals. Mirex, the most widely cited, was primarily used as an insecticide and has been banned. The remaining compounds are predominantly variants and derivatives of the Dechlorane Plus flame retardant, which is a REACH Substance of Very High Concern.

J.1.2 INDUSTRY PRODUCTION AND USE

Most of the available information from EPA focuses on three of the 19 PHCC chemicals, which are both active TSCA Inventory substances (CAS Nos. 115-27-5, 13560-89-9, and 1770-80-5). These substances account for all reported PHCC production (manufacturing or importing) activity in the United States.

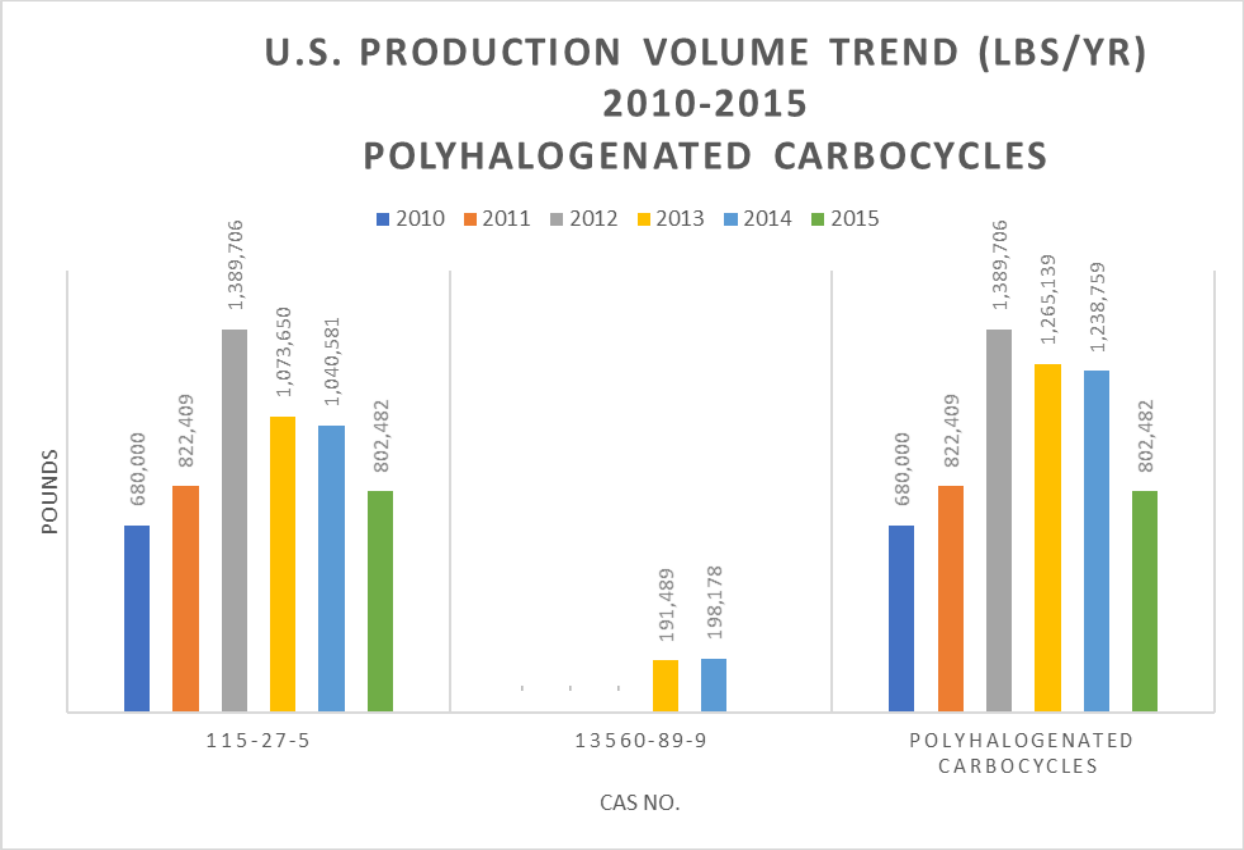
For the most recent year available from EPA, 2015, U.S. industry reported manufacturing and importing PHCCs into the United States. Specifically, industry submitted one reports of manufacturing activity (CAS No. 13560-89-9), and two reports of importing activity (one each for CAS Nos. 115-27-5, 13560-89-9).

Total reported production volume (manufacturing plus importing) in 2015 included 800,000 pounds for 115-27-5, and the PV for this chemical has exceeded 1 million pounds (high production volume) in prior years. The PV for CAS No. 13560-89-9 was reported as CBI. Production volume (PV) trend data for 2010-2015 indicates the combined PV for reported substances averaged 1.0 million pounds per year.

Data from EPA indicate that PVs of PHCC chemicals have remained relatively steady in recent years, at between 600,000 and 1.2 million pounds per year. An historical review of the reporting data reveals that

[22] The Toxic Substances Control Act (TSCA) Inventory is a list of chemical substances manufactured in or imported to the United States at some time since June 2006. For more information see https://www.epa.gov/tsca-inventory/tsca-inventory-notification-active-inactive-rule.

one additional PHCC chemical, CAS No. 1770-80-5 was reported in production in 1998, but no subsequent reports have been submitted.



Industry identified eight processing and use activities for PHCC substances in 2015, of which six involved processing or use as a flame retardant. From industry reporting to EPA uses as a flame retardant included:

- Plastic material and resin manufacturing (1 report)
- Paint and coating manufacturing (1 report)
- Miscellaneous manufacturing (1 report)
- CBI (3 reports)

Three reports for CAS No. 13560-89-9 identified a consumer/commercial use, but no reports identified a children's product use. This is consistent with product testing data found in the literature search and with reporting from the HPCDS, which provide no indication that PHCCs are associated with children's products. Gaps in information within the supply chain, however, may make it difficult for industry to know or reasonably ascertain if hazardous chemicals are or will be used in consumer or children's products.

Over the period 2015-2019, industry submitted a single report (in 2019) under the Toxics Release Inventory for CAS No. 2234-13-1. The waste volume managed for this chemical was claimed as CBI.

The use classification for the chemical was listed as:

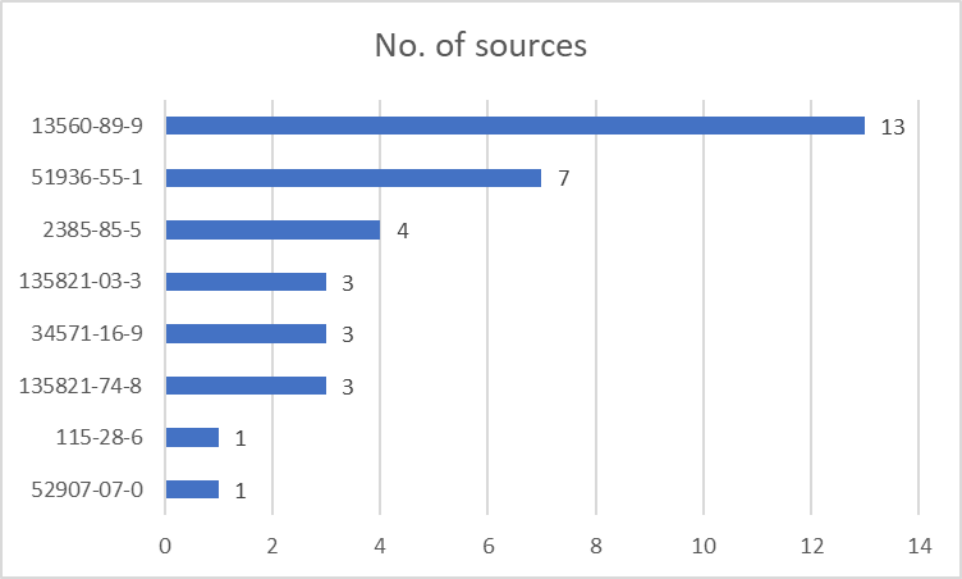
- 3.3C: Z301. Otherwise use: ancillary or other use (Cleaner)

This report was from the "primary metal" industry.

J.1.3 USE IN CONSUMER AND CHILDREN'S PRODUCTS

The states of Washington and Oregon require industry to report on chemicals of concern in products intended for use by children that are sold in those states. The reporting tool used by Washington and Oregon is known as the High Priority Chemicals Data System (HPCDS). According to data available from the HPCDS, manufacturers have not reported the use of potentially hazardous PHCCs in children's products.

PHCCs have been cited in 12 of the 187 literature sources reviewed. Among the eight PHCCs cited, chemicals appearing in the greatest number of these sources include: CAS No. 13560-89-9 (13 sources), CAS No. 51936-55-1 (7 sources) and CAS No. 2385-85-5 (4 sources).



Uses for PHCCs identified through the literature review (as described in Chapter 3) include:

CAS No. 13560-89-9: pipes, water barriers, kitchen hoods, and electronics; automotive plastics and electronic and electrical equipment; cable coating, computer monitors, furniture, and plastic roofing materials; CPE, elastomers, engineering thermoplastic, HIPS, PE, PP, thermosets in wire/cable, electronics, and construction materials.

CAS No. 34571-16-9: plastics, rubber, paint, and electrical equipment.

CAS No. 51936-55-1: styrenic polymers, such as polystyrene butadiene rubber

J.2 PHCCS ON NATIONAL AND INTERNATIONAL INVENTORIES AND REGISTRIES

Chemicals in class: 19

- 7 active on TSCA Inventory (recently manufactured/imported in U.S.)[23]
- 5 inactive on TSCA Inventory (no longer manufactured/imported in U.S.)
- 7 not on TSCA Inventory (never manufactured/imported in U.S.)

PHCCS ON THE TSCA ACTIVE INVENTORY	
115-27-5	Chlorendic anhydride
115-28-6	Chlorendic acid
1770-80-5	Dibutyl chlorendate
2234-13-1	1,2,3,4,5,6,7,8-Octachloronaphthalene
13560-89-9	Dechlorane Plus
34571-16-9	1,2,3,4,7,7-Hexachloro-5-(pentabromophenyl)bicyclo[2.2.1]hept-2-ene
52907-07-0	N,N'-(Ethylene)bis[4,5-dibromohexahydro-3,6-methanophthalimide]
PHCCS ON THE TSCA INACTIVE INVENTORY	
1773-89-3	Chlorendate dimethyl
18300-04-4	1,2-Dibromo-4,5,6,7,8,8-hexachloro-2,3,3a,4,7,7a-hexahydro-4,7-methano-1H-indene
31107-44-5	1,2,3,4,6,7,8,9,10,10,11,11-dodecachloro-1,4,4a,5a,6,9,9a,9b-octahydro-1,4:6,9-dimethanodibenzofuran
40703-79-5	4,7-Methano-1H-isoindole-1,3(2H)-dione, 5,6-dibromohexahydro-2-phenyl-
51936-55-1	7,8-Dibromo-1,2,3,4,11,11-hexachloro-1,4,4a,5,6,7,8,9,10,10a-decahydro-1,4-methanobenzocyclooctene

OTHER PHCCS ON INTERNATIONAL REGISTRIES		
13560-92-4	1,4:5,8:9,10-Trimethanoanthracene, 1,2,3,4,5,6,7,8,12,12,13,13-dodecachloro-1,4,4a,5,8,8a,9,9a,10,10a-decahydro-	Japan CSCL
2385-85-5	Mirex	Japan CSCL, Mexico INSQ

[23] "Active" indicates that U.S. manufacturing or importing activity has been reported since June 2006.

J.3 U.S. MANUFACTURING AND IMPORTING ACTIVITY, 2015

NUMBER OF REPORTS BY ACTIVITY TYPE						
PHCCS	MANUFACTURE	IMPORT	BOTH MANUFACTURE AND IMPORT	NOT SPECIFIED	CBI	TOTAL
115-27-5		1				1
13560-89-9	1	1				2
Total	**1**	**2**				**3**

Source: U.S. EPA, CDR (2016).

J.4 U.S. MANUFACTURING AND IMPORTING VOLUMES, 2015

REPORTED VOLUMES BY ACTIVITY TYPE					
PHCCS	MANUFACTURE	IMPORT	PRODUCTION VOLUME (MANUFACTURE + IMPORT)	USED	EXPORTED
115-27-5	-	802,482	802,482	-	802,482
13560-89-9	-	-	-	-	-
Total	**-**	**802,482**	**802,482**	**-**	**802,482**

-- data CBI or otherwise not disclosed
Source: U.S. EPA, CDR (2016).

J.5 U.S. PRODUCTION VOLUME TRENDS, 2012-2015

PHCCS	PV 2015	PV 2014	PV 2013	PV 2012
115-27-5	802,482	1,040,581	1,073,650	1,389,706
13560-89-9	-	198,178	191,489	-
Total	**802,482**	**1,238,759**	**1,265,139**	**1,389,706**

-- data CBI or otherwise not disclosed
PV = manufacturing plus importing
Source: U.S. EPA, CDR (2016).

J.6 TYPE OF PROCESSING OR USE REPORTS, 2015

NUMBER OF REPORTS								
PHCCS	Processing as a Reactant	Processing—Incorporation Into Article	Processing—Incorporation Into Formulation, Mixture, or Reaction Product	Processing—Repackaging	Use—Non-Incorporative Activities	CBI	NKRA	Grand Total
115-27-5			2					2
13560-89-9			4	1			1	6
Total			**6**	**1**			**1**	**8**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

J.7 INDUSTRIAL USE REPORTS, 2015

NUMBER OF REPORTS																							
PHCCS	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
115-27-5													1			1							2
13560-89-9											1											4	1	6
Total											**1**		**1**			**1**						**4**	**1**	**8**
USED AS FLAME RETARDANT																								
115-27-5													1			1							2
13560-89-9											1											3		4
Total											**1**		**1**			**1**						**3**		**6**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

J.8 INDUSTRIAL FUNCTION REPORTS, 2015

NUMBER OF REPORTS															
PHCCS	Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Other	Paint Additives and Coating Additives Not Described by Other Categories	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	CBI	NKRA	Grand Total
115-27-5				2											2
13560-89-9				4		1								1	6
Total				**6**		**1**								**1**	**8**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

J.9 INDUSTRIAL SECTOR REPORTS, 2015

NUMBER OF REPORTS: POLYHALOGENATED CARBOCYCLES																								
PHCC	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
ALL INDUSTRIAL FUNCTIONS																								
Total											1		1			1						4	1	8
115-27-5													1			1								2
13560-89-9											1											4	1	6
USED AS FLAME RETARDANT																								
Total											1		1			1						3		6
115-27-5													1			1								2
13560-89-9											1											3		4

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

J.10 CONSUMER AND CHILDREN'S PRODUCT USE REPORTS, 2015

NUMBER OF REPORTS						
PHCCS	COMMERCIAL	CONSUMER	CONSUMER AND COMMERCIAL	NKRA	CBI	TOTAL
13560-89-9			3			3

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

For 13560-89-9, one report each for: *building/construction materials not covered elsewhere, electrical and electronic products, and plastic and rubber products not covered elsewhere*

PHCCS	CHILDREN'S PRODUCT USE	NKRA	OTHER USE	TOTAL
13560-89-9				

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

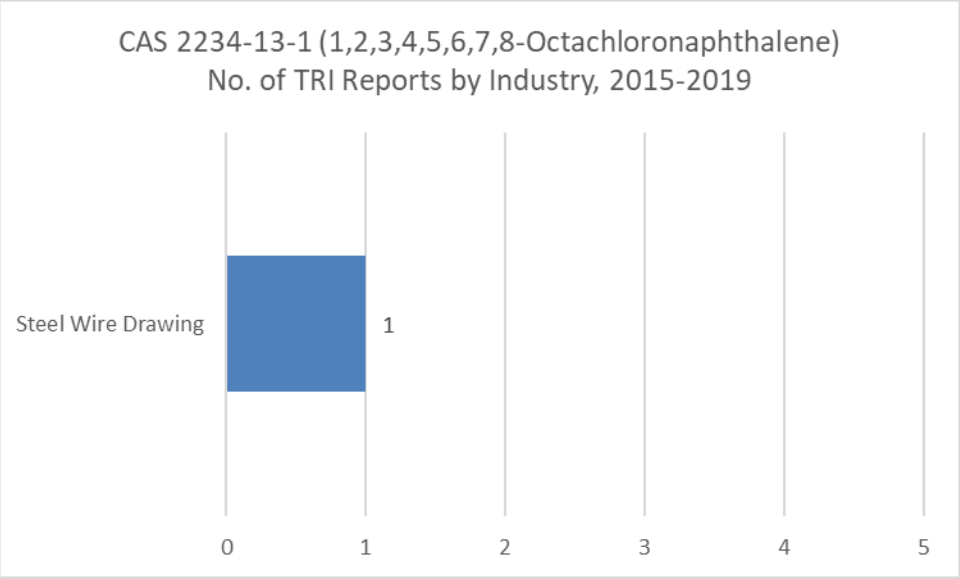
J.11 TOXIC RELEASE INVENTORY REPORTS

TRI-REPORTABLE CHEMICALS	
2234-13-1	1,2,3,4,5,6,7,8-Octachloronaphthalene

TOTAL PRODUCTION-RELATED WASTE REPORTED							
PHCCS		2015	2016	2017	2018	2019	GRAND TOTAL
2234-13-1	No. of Reports					1	1
	Pounds of waste managed					--	--

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TRI REPORTS BY INDUSTRY



Source: U.S. EPA, Toxics Release Inventory (2015-2019).

J.12 HIGH PRIORITY CHEMICALS DATA SYSTEM REPORTS

NUMBER OF REPORTS BY YEAR											
PHCCS		2012	2013	2014	2015	2016	2017	2018	2019	2020[1]	TOTAL
None	Total										
	FR										
	Conc>1%										

[1] Partial year reporting.
Source: Interstate Chemicals Clearinghouse (2021).

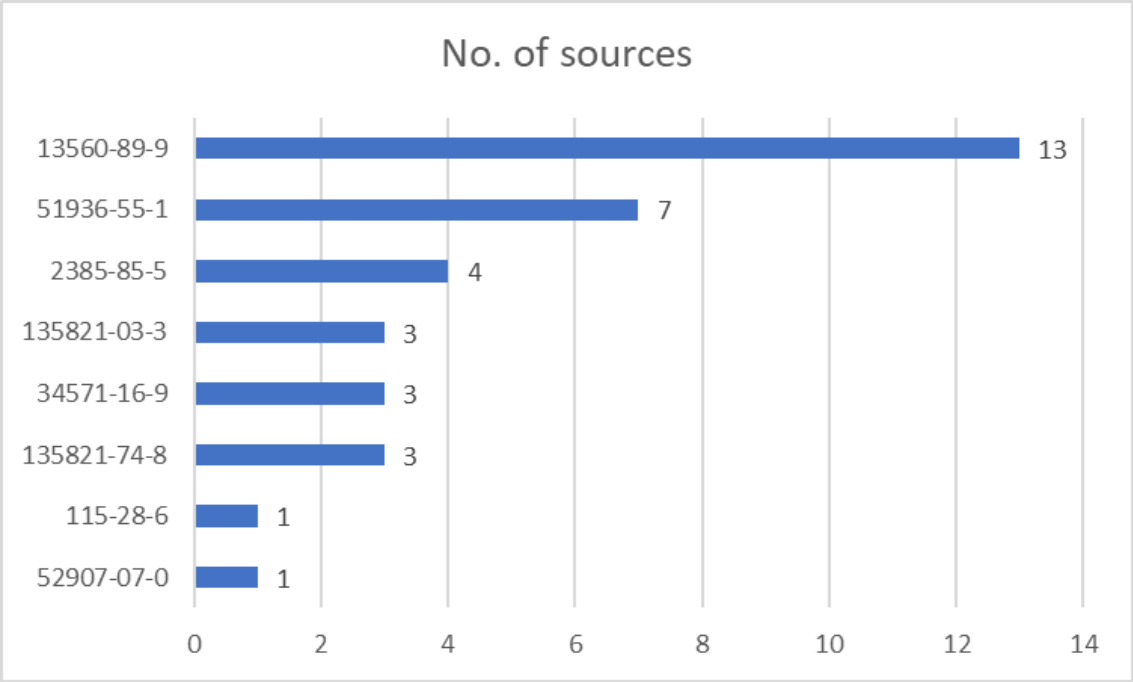
J.13 PATENT COUNTS FROM PUBCHEM

		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
115-27-5	8265	415	1,274	3,284	**4,973**	58	56	134	**248**	34	38	52	**124**
115-28-6	8266	1,458	2,859	7,344	**11,661**	180	179	687	**1,046**	81	93	447	**621**
1770-80-5	221178	20	26	64	**110**	3	3	9	**15**	1	0	1	**2**
1773-89-3	164881	1	0	2	**3**	0	0	0	**0**	0	0	0	**0**
2234-13-1	16692	75	120	361	**556**	5	1	0	**6**	3	0	0	**3**
2385-85-5	16945	492	1,931	8,958	**11,381**	151	427	480	**1,058**	105	274	240	**619**
13560-89-9	26111	72	519	1,486	**2,077**	48	239	710	**997**	36	167	546	**749**
13560-90-2	46781604	0	1	0	**1**	0	0	0	**0**	0	0	0	**0**
13560-91-3	260487	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
13560-92-4	13595583	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
18300-04-4	86700	4	0	0	**4**	4	0	0	**4**	4	0	0	**4**
31107-44-5	35733	1	1	0	**2**	1	0	0	**1**	1	0	0	**1**
34571-16-9	118174	2	1	0	**3**	2	0	0	**2**	2	0	0	**2**
40703-79-5	93224	2	0	0	**2**	1	0	0	**1**	1	0	0	**1**
51936-55-1	93266	3	2	0	**5**	3	2	0	**5**	3	0	0	**3**
52907-07-0	93281	0	29	98	**127**	0	21	47	**68**	0	16	44	**60**
71245-27-7	97944743	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
135821-03-3	14178853	0	0	3	**3**	0	0	0	**0**	0	0	0	**0**
135821-74-8	14178854	0	175	97	**272**	0	0	0	**0**	0	0	0	**0**
855992-98-2	154735127	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
855993-01-0	154735128	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**

Source: PubChem Patent Data (See Exhibit 2-1 in main report and on OFR_universe_wPCPy_10122021.xlsx, tab 'Patent Info by CID' in Supplemental Information)

J.14 PHCCS CITED IN LITERATURE REVIEW

PHCCs are mentioned or referenced in 12 of the 187 sources reviewed.



In this section, the following OECD use codes for chemicals are listed according to the internationally harmonized functional, product and article use categories:[24]

- AC4a. Stone, plaster, cement, glass and ceramic articles. Construction and building materials covering large surface areas. Examples: Cement flooring, Cement flooring, stone tile, mirrors, sinks, bathtubs.
- AC13e. Plastic articles (hard). Furniture & furnishings, including furniture coverings. Examples: Computer casing.
- AC13f. Plastic articles (hard). Other articles with routine direct contact during normal use. Examples: Handles, pencils, handheld device casing.

J.14.1 13560-89-9 DECHLORANE PLUS

- This chemical was referenced in 13 sources
- One source mentioned product testing data, including concentration data:
    - Electrical and electronic equipment and e-waste: maximum of 0.0033 percent
    - Construction materials: 0.0064 percent
    - Textiles: 0.0001 percent

[24] Source: OECD (2017).

- Two sources cited use in consumer products (kitchen hoods, electronics; computer monitors, furniture)
- Three sources reported human or environmental exposure data
- OECD use codes for this chemical included AC13e, AC13f
- One source cited 2004 global demand of over 170,000 tons. Another source stated that in 2011, five companies in the United States reported a total of 60,000 tons manufactured or imported.
- According to these sources, this chemical has been used in: plastic in automobiles; waste electronic and electrical equipment; pipes; water barriers; kitchen hoods; and electronics
- Two sources mentioned this chemical in the context of use trends over time, 1 addressed end of life issues, and six mentioned laws or regulations.

J.14.2 51936-55-1 7,8-DIBROMO-1,2,3,4,11,11-HEXACHLORO-1,4,4A,5,6,7,8,9,10,10A-DECAHYDRO-1,4-METHANOBENZOCYCLOOCTENE

- This chemical was referenced in seven sources
- Two sources mentioned product testing data and presented concentration data
- Waste electronics, vehicles, construction material: not detected
- Textiles: maximum 0.001 percent
- Decorative laminates in China: 0.0066 percent
- No sources cited use in consumer products or children's products
- One source reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources identified production data for this chemical
- According to these sources, this chemical has been used in: styrenic polymers such as polystyrene butadiene rubber
- One source mentioned alternatives to use of this chemical, one addressed end of life issues, and one mentioned laws or regulations.

J.14.3 2385-85-5 MIREX

- This chemical was referenced in four sources
- No sources mentioned product testing data or presented concentration data
- One source cited use in consumer products (electrical and electronic devices, flooring, fabric, upholstery)
- 4 sources reported human or environmental exposure data
- OECD use codes for this chemical included AC4a
- One source indicated production of this chemical ceased in the 1970s
- According to these sources, this chemical was used as a flame retardant in plastics, rubber, paint, paper, and electrical goods.
- Two sources mentioned this chemical in the context of use trends over time and one discussed alternatives to its use.

J.14.4 135821-03-3 DECHLORDANE PLUS (SYN ISOMER)

- This chemical was referenced in three sources
- One source mentioned product testing data, but wipe samples from a variety of home and office products showed no detection.
- No sources cited use in consumer products or children's products
- One source reported human or environmental exposure data
- OECD use codes for this chemical included AC13e
- No sources mentioned this chemical in the context of use trends over time, alternatives to its use, end of life issues, or laws or regulations

J.14.5 34571-16-9 1,2,3,4,7,7-HEXACHLORO-5-(PENTABROMOPHENYL)BICYCLO[2.2.1]HEPT-2-ENE

- This chemical was referenced in three sources
- No sources mentioned product testing data or presented concentration data
- No sources cited use in consumer products or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- According to these sources, this chemical has been used as an additive flame retardant in plastics, rubber, paint, and electrical equipment.
- No sources mentioned this chemical in the context of use trends over time, alternatives to its use, end of life issues, or laws or regulations

J.14.6 135821-74-8 ANTI-DECHLORANE PLUS

- This chemical was referenced in three sources
- One source mentioned product testing data, but wipe samples from a variety of home and office products showed no detection.
- No sources cited use in consumer products or children's products
- One source reported human or environmental exposure data
- OECD use codes for this chemical included AC13e
- No sources mentioned this chemical in the context of use trends over time, alternatives to its use, end of life issues, or laws or regulations.

J.14.7 115-28-6 CHLORENDIC ACID

- This chemical was referenced in one source
- No sources mentioned product testing data or presented concentration data
- No sources cited use in consumer products or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No specific uses for this chemical were identified
- No sources mentioned this chemical in the context of use trends over time, alternatives to its use, end of life issues, or laws or regulations.

J.14.8 52907-07-0 N,N'-(ETHYLENE)BIS[4,5-DIBROMOHEXAHYDRO-3,6-METHANOPHTHALIMIDE]

- This chemical was referenced in one source
- No sources mentioned product testing data or presented concentration data
- No sources cited use in consumer products or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No specific uses for this chemical were identified
- No sources mentioned this chemical in the context of use trends over time, alternatives to its use, end of life issues, or laws or regulations.

J.15 LITERATURE SOURCES USED

Abbasi, G., Saini, A., Goosey, E., & Diamond, M. L. (2016). Product screening for sources of halogenated flame retardants in Canadian house and office dust. *Science of The Total Environment, 545*, 299-307.

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Ekpe, O. D., Choo, G., Barceló, D., & Oh, J.-E. (2020). Introduction of emerging halogenated flame retardants in the environment *Comprehensive Analytical Chemistry* (Vol. 88, pp. 1-39): Elsevier.

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Lee, H. K., Kang, H., Lee, S., Kim, S., Choi, K., & Moon, H. B. (2020). Human exposure to legacy and emerging flame retardants in indoor dust: A multiple-exposure assessment of PBDEs. *Science of The Total Environment, 719*.

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Wypych, G. (2021). *Handbook of Flame Retardants*. Toronto: ChemTech Publishing.

Zuiderveen, E. A. R., Slootweg, J. C., & de Boer, J. (2020). Novel brominated flame retardants - A review of their occurrence in indoor air, dust, consumer goods and food. *Chemosphere, 255*, 126816.

APPENDIX K | POLYHALOGENATED DIPHENYL ETHERS

K.1 CHEMICAL LIST – PHDES

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
ALL	**Across all 223 PHDEs**		**11**	**47**	**45**	**NA**	**220**	**82**	**NA**	**NA**	**20**
101-55-3	p-Bromodiphenyl ether	BDE-3; 4-Bromodiphenyl ether	1	1	3	med	0.8404	1,653	56%	50%	2
103173-66-6	1,1'-Oxybis(3,5-dibromobenzene)		0	1		low	0.9625	3	67%		1
1163-19-5	1,1'-Oxybis[2,3,4,5,6-pentabromobenzene]	BDE-209; DecaBDE; Decabromobiphenyl oxide	4.5	1	47	high	0.9954	28,604	68%	67%	16
116995-32-5	1,2,4,5-Tetrabromo-3-(2,4,6-tribromophenoxy)benzene		0	1		med	0.9946	0			1
116995-33-6	BDE-147		0	1		low	0.9884	0			1
117948-63-7	Benzene, 1,2,3,5-tetrabromo-4-(2,4,6-tribromophenoxy)-	BDE-184	0	1	1	med	0.997	8	100%		1
117964-21-3	BDE-197		0	0	6	med	0.997	11	100%	100%	
147217-71-8	1-Bromo-2-(4-bromophenoxy)benzene		0	1		med	0.9447	34	74%	0%	
147217-72-9	BDE-6		0	1		low	0.9765	6	67%	100%	
147217-73-0	BDE-19		0	1		low	0.9877	0			
147217-74-1	1,2-Dibromo-3-(2-bromophenoxy)benzene	BDE-16	0	1		low	0.9862	0			
147217-75-2	2,2',4-Tribromodiphenyl ether	BDE-17	0	1	3	med	0.9859	10	100%		
147217-76-3	BDE-20		0	1		low	0.9862	0			
147217-77-4	2,4-Dibromo-1-(3-bromophenoxy)benzene	BDE-25	0	1		low	0.992	0			

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
147217-78-5	2',3,4-Tribromodiphenyl ether	BDE-33	0	1		med	0.9817	161	37%	27%	
147217-79-6	1,3-Dibromo-5-(3-bromophenoxy)benzene	BDE-36	0	1		low	0.9625	0			
147217-80-9	BDE-35		0	1		low	0.9228	0			
147217-81-0	BDE-37		0	1		low	0.9228	1	100%		
155999-95-4	2,4,6-Tribromodiphenyl ether	BDE-30	0	1		med	0.9966	6	67%		
171977-44-9	2,4-Dibromo-1-phenoxybenzene		0	1		low	0.9895	8	38%	100%	
182346-21-0	2,2',3,4,4'-Pentabromodiphenyl ether	BDE-85	0	0	8	med	0.9971	49	100%	100%	
182677-28-7	1,1'-Oxybis(2,3,4-tribromobenzene)	BDE-128	0	0		med	0.9971	45	49%	43%	
182677-30-1	2,2',3,4,4',5'-Hexabromodiphenyl Ether	BDE-138	0	0	4	med	0.9948	15	100%	100%	
189084-57-9	1,3-Dibromo-2-(2,4-dibromophenoxy)benzene	BDE-51	0	0		low	0.9859	0			
189084-58-0	BDE-166		0	0		low	0.9954	0			
189084-59-1	3,4-Dibromodiphenyl ether		0	0		low	0.952	4	25%		
189084-60-4	BDE-32		0	0	1	low	0.9859	0			
189084-61-5	2,3',4,4'-Tetrabromodiphenyl ether	BDE-66	0	0	9	med	0.9945	17	100%		
189084-62-6	2,3',4',6-Tetrabromodiphenyl Ether	BDE-71	0	0	4	med	0.9945	19	100%		
189084-63-7	BDE-75		0	0		low	0.9955	3	100%		
189084-64-8	2,2',4,4',6-Pentabromodiphenyl ether	BDE-100	0	0	22	high	0.9955	93	80%	100%	1
189084-65-9	1,2,3,4,5-Pentabromo-6-phenoxybenzene	BDE-116	0	1		low	0.9955	2,615	72%	59%	1
189084-66-0	2,3',4,4',6-Pentabromodiphenyl Ether	BDE-119	0	0	3	med	0.9979	18	100%	100%	
189084-67-1	1,2,3,4,5-Pentabromo-6-(2,4-dibromophenoxy)benzene		0	0		med	0.9954	0			

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189084-68-2	2,3,3',4,4',5,6-Heptabromodiphenyl Ether	BDE-190	0	0	2	med	0.9954	2	100%		1
2050-47-7	4,4'-Dibromodiphenyl ether	BDE-15	1	1	2	med	0.7698	1,470	59%	74%	
207122-15-4	2,2',4,4',5,6'-Hexabromodiphenyl ether	BDE-154	0	1	15	high	0.9946	104	100%	100%	2
207122-16-5	2,2',3,4,4',5',6-Heptabromodiphenyl ether	BDE-183	0	1	16	high	0.997	71	100%	100%	2
218304-36-0	BDE-24		0	0		low	0.9928	0			
243982-82-3	2,2',4,5'-Tetrabromodiphenyl Ether	BDE-49	0	0	3	med	0.9891	41	100%		
243982-83-4	BDE-140		0	0		low	0.9987	0			
259087-35-9	BDE-189		0	0		low	0.9948	0			
32534-81-9	Pentabromodiphenyl ether	PentaDBE	1	1	19	high	0.9884	No CID			17
32536-52-0	Octabromodiphenyl ether	BDE-194; OctaBDE	1	1	21	high	0.9948	4,858	70%	71%	15
32577-34-7	Benzene, pentabromo(2,3dibromopropoxy)		0	0		low	0.982	120	80%	75%	
327185-09-1	BDE-69		0	0		low	0.9979	0			
327185-11-5	Benzene, 1,2,3-tribromo-4-(2,3-dibromophenoxy)-	BDE-82	0	0		low	0.9971	0			
327185-13-7	BDE-170		0	0		low	0.9948	0			
337513-53-8	1,3-Dibromo-2-(3-bromophenoxy)benzene		0	0		low	0.9936	0			
337513-54-9	BDE-38		0	0		low	0.9926	0			
337513-55-0	BDE-48		0	0		low	0.9884	0			
337513-56-1	BDE-29		0	0		low	0.99	0			
337513-66-3	BDE-9		0	0		low	0.9779	16	94%		
337513-67-4	BDE-21		0	0		low	0.9973	43	60%	55%	

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337513-68-5	BDE-41		0	0		low	0.9971	0			
337513-72-1	BDE-203		0	0	3	med	0.9954	2,500	63%	58%	
337513-75-4	1,4-Dibromo-2-(3-bromophenoxy)benzene		0	0		low	0.9688	0			
337513-77-6	BDE-40		0	0		low	0.9862	188	55%	71%	
337513-82-3	BDE-57		0	0		low	0.9918	0			
35854-94-5	2,2',4,4',6,6'-Hexabromodiphenyl Ether	BDE-155	0	1	1	low	0.9955	73	67%	79%	1
36065-30-2	1,3,5Tribromo2(2,3dibromo2methylpropoxy)benzene		0	0		low	0.973	1	0%		2
36483-60-0	Hexabromodiphenyl ether		1	1	3	med	0.9946	No CID			4
366791-32-4	1,2,3-Tribromo-5-(3,4-dibromophenoxy)benzene	BDE-126	0	0	1	med	0.9908	6	100%		
373594-78-6	BDE-105		0	0		low	0.9971	0			
38463-82-0	1,3,5-Tribromo-2-(2,3-dibromophenoxy)benzene		0	0		low	0.9979	1	0%		
40088-47-9	Tetrabromodiphenyl ether		1	1	2	high	0.9971	0			4
405237-85-6	1,2,3,4-Tetrabromo-5-(3,4-dibromophenoxy)benzene	BDE-156	0	0	1	med	0.9948	9	100%		
405237-86-7	1,2,3,4,5-Pentabromo-6-(2,5-dibromophenoxy)benzene		0	0		low	0.9954	0			
407578-53-4	1,2,3,4,5-Pentabromo-6-(3,5-dibromophenoxy)benzene		0	0		low	0.9954	0			
407606-55-7	BDE-18		0	0		low	0.9688	0			
407606-57-9	1,3-Dibromo-5-(4-bromophenoxy)benzene	BDE-39	0	0		low	0.9529	0			
407606-59-1	BDE-172		0	0		low	0.9948	0			
407606-61-5	BDE-176		0	0		low	0.997	0			

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41318-75-6	2,4,4'-Tribromodiphenyl ether	BDE-28	0	1	13	high	0.9859	31	74%		
41424-36-6	1,3,5Tribromo2methoxy4methylbenzene		0	1		low	0.8857	5	0%		
417727-71-0	1,2,4-Tribromo-5-(3,5-dibromophenoxy)benzene		0	0		low	0.9884	0			
437701-78-5	2,2',3,3',4,5,5',6,6'-nonabromodiphenyl ether	BDE-208	0	0	2	med	0.9954	8	50%	33%	
437701-79-6	BDE-207		0	0	5	med	0.9954	7	100%		
442690-45-1	BDE-182		0	0		low	0.997	7	100%		
446254-15-5	BDE-22		0	0		low	0.9817	1	100%	100%	
446254-16-6	BDE-23		0	0		low	0.9928	0			
446254-17-7	BDE-34		0	0		low	0.9936	0			
446254-18-8	BDE-42		0	0		low	0.9945	0			
446254-19-9	BDE-43		0	0		low	0.9918	0			
446254-20-2	BDE-44		0	0		low	0.9811	0			
446254-21-3	BDE-45		0	0		low	0.9918	0			
446254-22-4	BDE-46		0	0		low	0.9954	0			
446254-23-5	BDE-50		0	0		low	0.9955	0			
446254-24-6	BDE-52		0	0		low	0.9688	5	20%		
446254-25-7	BDE-53		0	0		low	0.9913	0			
446254-26-8	BDE-54		0	0		low	0.9877	50	52%	63%	
446254-27-9	1,2,3-Tribromo-4-(3-bromophenoxy)benzene		0	0		low	0.9971	0			
446254-28-0	BDE-56		0	0		low	0.9817	0			
446254-29-1	BDE-58		0	0		low	0.9954	0			
446254-30-4	BDE-59		0	0		low	0.9918	0			

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446254-31-5	BDE-60		0	0		low	0.9971	731	80%	72%	
446254-32-6	BDE-61		0	0	2	low	0.9953	212	59%	48%	
446254-33-7	BDE-62		0	0		low	0.997	0			
446254-34-8	BDE-63		0	0		low	0.9884	0			
446254-35-9	BDE-64		0	0		low	0.9884	0			
446254-36-0	BDE-65		0	0		low	0.9928	0			
446254-37-1	BDE-67		0	0		low	0.9884	0			
446254-38-2	2,4-Dibromo-1-(3,5-dibromophenoxy)benzene	BDE-68	0	0		low	0.992	0			
446254-39-3	BDE-70		0	0		low	0.9752	10	0%		
446254-40-6	BDE-72		0	0		low	0.9913	0			
446254-41-7	BDE-73		0	0		low	0.9936	0			
446254-42-8	BDE-74		0	0		low	0.9884	0			
446254-43-9	BDE-76		0	0		low	0.9971	0			
446254-45-1	BDE-78		0	0		low	0.9908	0			
446254-48-4	BDE-79		0	0		low	0.9788	0			
446254-50-8	BDE-81		0	0		low	0.9908	0			
446254-51-9	BDE-83		0	0		low	0.9918	0			
446254-52-0	BDE-84		0	0		low	0.9918	0			
446254-53-1	BDE-86		0	0		low	0.9948	0			
446254-54-2	BDE-87		0	0		low	0.996	0			
446254-55-3	BDE-88		0	0		low	0.997	0			
446254-56-4	BDE-89		0	0		low	0.9971	0			
446254-57-5	1,2,5-Tribromo-3-(2,4-dibromophenoxy)benzene	BDE-90	0	0		low	0.9884	0			
446254-58-6	BDE-91		0	0		low	0.9884	0			

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446254-59-7	BDE-92		0	0		low	0.9918	0			
446254-60-0	1,2,4,5-Tetrabromo-3-(2-bromophenoxy)benzene		0	0		low	0.9918	0			
446254-61-1	BDE-94		0	0		low	0.9918	0			
446254-62-2	BDE-95		0	0		low	0.9918	0			
446254-63-3	BDE-96		0	0		low	0.9918	0			
446254-64-4	BDE-97		0	0		low	0.9884	0			
446254-65-5	BDE-101		0	0		low	0.9884	0			
446254-66-6	BDE-102		0	0		low	0.9884	0			
446254-67-7	BDE-103		0	0		low	0.9964	0			
446254-68-8	BDE-104		0	0		low	0.9955	0			
446254-69-9	BDE-106		0	0		low	0.9948	0			
446254-70-2	BDE-107		0	0		low	0.9884	0			
446254-71-3	BDE-108		0	0		low	0.9971	0			
446254-72-4	BDE-109		0	0		low	0.997	0			
446254-73-5	BDE-110		0	0		low	0.9884	0			
446254-74-6	BDE-111		0	0		low	0.9918	0			
446254-75-7	BDE-112		0	0		low	0.9918	0			
446254-76-8	BDE-113		0	0		low	0.9918	0			
446254-77-9	BDE-114		0	0		low	0.9948	0			
446254-78-0	BDE-115		0	0		low	0.997	0			
446254-79-1	BDE-117		0	0		low	0.9884	0			
446254-80-4	1,2,4-Tribromo-5-(3,4-dibromophenoxy)benzene	BDE-118	0	0		low	0.9884	1	100%		
446254-81-5	BDE-121		0	0		low	0.9979	2	100%		
446254-82-6	BDE-122		0	0		low	0.9971	0			

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446254-83-7	BDE-123		0	0		low	0.9971	0			
446254-84-8	BDE-124		0	0		low	0.996	0			
446254-85-9	BDE-125		0	0		low	0.9971	0			
446254-86-0	BDE-127		0	0		low	0.9908	0			
446254-87-1	BDE-129		0	0		low	0.9948	0			
446254-88-2	1,2,3-Tribromo-4-(2,3,5-tribromophenoxy)benzene		0	0		low	0.9948	0			
446254-89-3	BDE-131		0	0		low	0.997	0			
446254-90-6	BDE-132		0	0		low	0.9948	0			
446254-91-7	BDE-133		0	0		low	0.9918	0			
446254-92-8	BDE-134		0	0		low	0.9918	0			
446254-93-9	BDE-135		0	0		low	0.9918	0			
446254-94-0	BDE-136		0	0		low	0.9918	0			
446254-95-1	BDE-137		0	0		low	0.9948	1	100%		
446254-96-2	1,2,3,5-Tetrabromo-4-(2,4-dibromophenoxy)benzene	BDE-139	0	0		low	0.997	0			
446254-97-3	BDE-141		0	0		low	0.9948	0			
446254-98-4	BDE-142		0	0	1	low	0.9954	384	52%	60%	
446254-99-5	BDE-143		0	0		low	0.9948	0			
446255-00-1	BDE-144		0	0		low	0.997	0			
446255-01-2	BDE-145		0	0		low	0.997	0			
446255-02-3	BDE-146		0	0		low	0.9884	0			
446255-03-4	BDE-148		0	0	1	low	0.9946	307	36%	41%	
446255-04-5	BDE-149		0	0		low	0.9884	0			
446255-05-6	BDE-150		0	0		low	0.9946	0			
446255-06-7	BDE-151		0	0		low	0.9918	0			

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446255-07-8	BDE-152		0	0		low	0.9918	0			
446255-08-9	BDE-157		0	0		low	0.9971	0			
446255-09-0	BDE-158		0	0		low	0.997	0			
446255-10-3	BDE-159		0	0		low	0.9948	0			
446255-11-4	BDE-160		0	0		low	0.9954	0			
446255-12-5	BDE-161		0	0		low	0.997	0			
446255-13-6	BDE-162		0	0		low	0.9948	0			
446255-14-7	BDE-163		0	0		low	0.9884	0			
446255-15-8	BDE-164		0	0		low	0.9948	0			
446255-16-9	BDE-165		0	0		low	0.9918	0			
446255-17-0	BDE-167		0	0		low	0.9948	0			
446255-18-1	BDE-169		0	0		low	0.9908	0			
446255-19-2	BDE-171		0	0		low	0.997	0			
446255-21-6	BDE-174		0	0		low	0.9948	0			
446255-22-7	BDE-175		0	1		low	0.997	0			2
446255-23-8	BDE-177		0	0		low	0.9948	0			
446255-24-9	BDE-178		0	0		low	0.9918	0			
446255-25-0	BDE-179		0	0		med	0.9918	0			
446255-26-1	BDE-180		0	0		med	0.9948	0			
446255-27-2	BDE-186		0	0		low	0.9954	0			
446255-28-3	BDE-187		0	0		low	0.9884	0			
446255-30-7	1,2,3,5-Tetrabromo-4-(3,4,5-tribromophenoxy)benzene	BDE-191	0	0	1	med	0.997	8	100%		
446255-34-1	BDE-193		0	0		low	0.9948	0			
446255-38-5	PBDE 195	BDE-195	0	0		med	0.9954	1,956	73%	69%	

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446255-39-6	BDE-196		0	0	6	med	0.997	18	100%	100%	
446255-42-1	BDE-198		0	0		med	0.9954	0			
446255-43-2	BDE-199		0	0		med	0.9948	0			
446255-46-5	BDE-200		0	0		med	0.9954	1	100%		
446255-50-1	BDE-201		0	0	2	med	0.997	2	100%		
446255-54-5	2,2',3,4,4',5,6,6'-Octabromodiphenyl ether	BDE-204	0	0		med	0.9954	2	100%		
446255-56-7	PBDE 205	BDE-205	0	0	1	med	0.9954	4	100%	100%	
46438-88-4	1,3-Dibromo-5-phenoxybenzene		0	0		low	0.9689	77	22%		
49690-94-0	Tribromodiphenyl ether	BDE-33	1	1		low	0.9817	161	37%	27%	
51452-87-0	BDE-4		0	1		low	0.9557	373	79%	84%	
51892-26-3	2,4Dichlorodiphenyl ether		0	0	2	low	0.9895	128	50%		
51930-04-2	Benzene, 1,3-dibromo-2-phenoxy-		0	1		med	0.99	1	100%		
53551-87-4	BDE-168		0	0		low	0.9987	0			
53563-56-7	Diphenyl ether, dibromo-		0	1		low		69	74%	83%	
5436-43-1	2,2',4,4'-Tetrabromodiphenyl ether	BDE-47	0	1	22	high	0.9859	214	96%	75%	3
58965-66-5	Perbromo-1,4-diphenoxybenzene		1	1	5	high	0.9954	47	89%	89%	1
60348-60-9	2,2',4,4',5-Pentabromodiphenyl ether	BDE-99; DE-71	0	1	23	high	0.9884	143	96%	91%	3
60371-14-4	Bromkal 70		0	0		low		No CID			
61288-13-9	Bromkal 80		0	0		low		No CID			
63387-28-0	1,2,3,4,5-Pentabromo-6-(2,3,4,5-tetrabromophenoxy)benzene	BDE-206	0	0	4	med	0.9954	232	71%	74%	
63936-56-1	Nonabromodiphenyl ether	BDE-206	1	1	3	high	0.9954	232	71%	74%	1
65075-08-3	1,4-Dibromo-2-(4-bromophenoxy)benzene		0	1		low	0.957	0			

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67797-09-5	BDE-202		0	0	1	med	0.9918	1	100%		
68631-49-2	2,2',4,4',5,5'-Hexabromodiphenyl ether	BDE-153	0	1	21	high	0.9884	89	99%	100%	4
6876-00-2	PBDE 002	3-Bromodiphenyl ether; 3-Phenoxybromobenzene	0	1		low	0.9196	393	62%		
68928-80-3	Diphenyl ether, heptabromo derivative		1	1	5	high	0.9954	111	62%	59%	3
6903-63-5	1,1'-Oxybis(3-bromobenzene)	BDE-11; PBDE-11	0	1		low	0.8827	95	33%		
7025-06-1	Benzene, bromophenoxy-	2-bromodiphenyl ether	0	1		med	0.9665	936	71%	75%	
79755-43-4	3,5Dibromo2(2,4dibromophenoxy) phenol		0	0		low	0.8982	51	82%	100%	
83694-71-7	1-Bromo-3-(4-bromophenoxy)benzene		0	1		low	0.834	56	34%		
85446-17-9	1,1'-Oxybis(2,3,4,5-tetrabromobenzene)	BDE-194	0	0		med	0.9948	4,858	70%	71%	
93703-48-1	BDE-77		0	1	2	med	0.9228	20	95%	100%	1

K.1.1 OVERVIEW

There are 223 substances in the OFR class "Polyhalogenated diphenyl ethers" (PHDEs), with key attributes described in the Summary by Chemical table (For field definitions and color scheme, see Guide to Summary Tables, Appendix B.1). Forty-seven of these substances are reported on one or more chemical inventories we reviewed. Of these, 11 are active TSCA Inventory[25] substances (none are inactive). All 11 active substances also appear on one or more non-U.S. inventories. An additional 36 substances not on the TSCA Inventory also appear on non-U.S. inventories, primarily that of Japan. The remaining 177 substances do not appear on any inventories we reviewed.

During our literature search, we found that 10 of the 11 PHDE chemicals found on the TSCA active inventory are referenced in the literature. We were also able to collect data for 10 PHDE chemicals identified in other inventories, and for 25 PHDEs not on any inventory. The patent data from PubChem reported information on 82 PHDE chemicals.

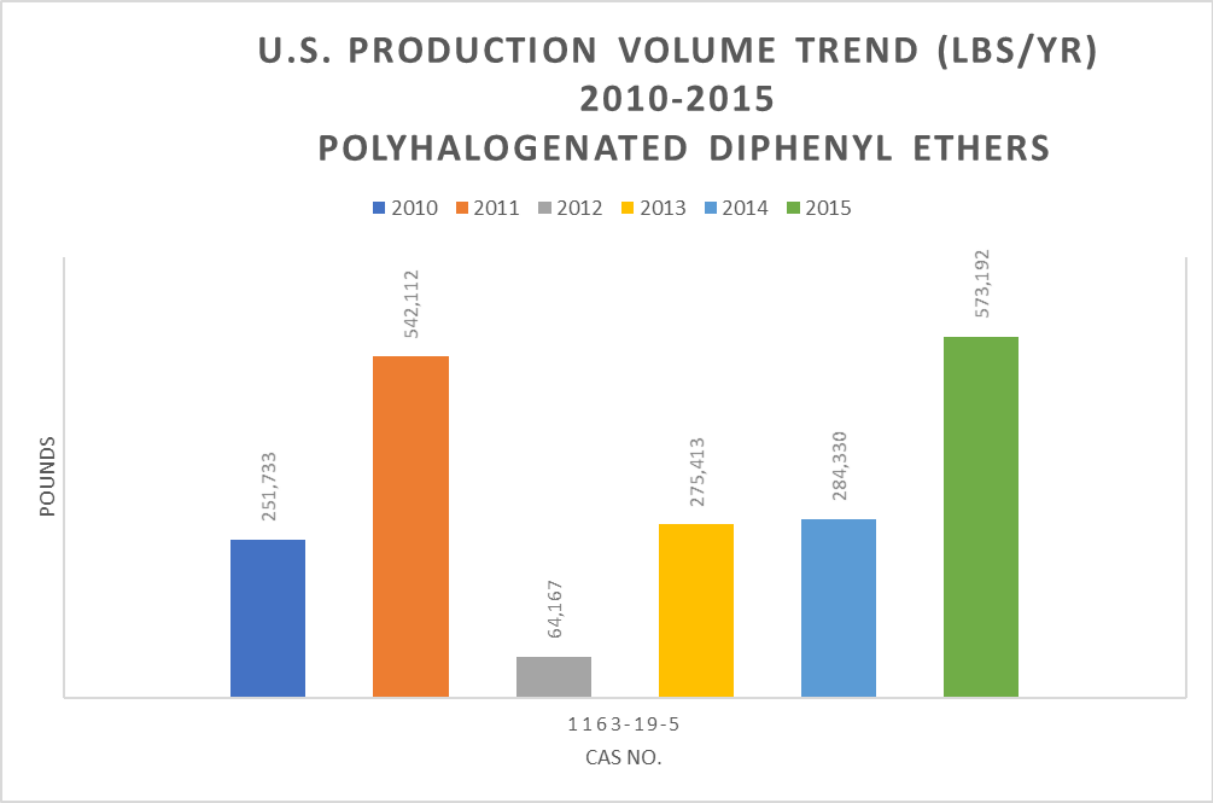
PHDEs are primarily different congeners of the polybrominated diphenyl ethers, i.e., different numbers and arrangements of bromine atoms around the central diphenyl ether structure. Chemicals are listed by both homologue groups (e.g., pentaBDE) and by specific isomeric chemicals within those groups (e.g. 2,2',4,4',5-pentabromodiphenyl ether). Most of the individual chemicals do not have industrial, patent, or literature information and are not noted on lists, but can be evaluated with their respective homologue group. The vast majority of available data and restrictions are for Deca-BDE, the fully brominated decabromo diphenyl ether.

K.1.2 INDUSTRY PRODUCTION AND USE

Most of the available information from EPA focuses on a single PHDE chemical, CAS No. 1163-19-5 (Deca-BDE), an active TSCA Inventory substance. It accounts for most of the production (manufacturing or importing) activity in the United States for the last several CDR reporting cycles.

For the most recent year available from EPA, 2015, U.S. industry submitted one report of manufacturing activity for CAS No. 1163-19-5, and four additional reports where the activity was not specified or was claimed as CBI.

[25] The Toxic Substances Control Act (TSCA) Inventory is a list of chemical substances manufactured in or imported to the United States at some time since June 2006. For more information see https://www.epa.gov/tsca-inventory/tsca-inventory-notification-active-inactive-rule.



Source: U.S. EPA, CDR (2011-2016).

In the literature, multiple sources estimate the global production of CAS No. 1163-19-5 at over 1 million pounds (high production volume). Other PHDE chemicals (CAS Nos. 32536-52-0, 32534-81-9, 1163-19-5) have previously been produced at over 1 million pounds, according to literature sources, but these three chemicals have been voluntarily phased out in the United States.

Total reported U.S. production volume (manufacturing plus importing) in 2015 was 573,000 pounds for CAS No. 1163-19-5. Production volume (PV) trend data for 2010-2015 indicates the combined PV for CAS No. 1163-19-5 averaged 331,000 pounds per year.

Data from EPA indicate that the PV of CAS No. 1163-19-5 has ranged from 200,000 to 600,000 pounds per year over the last decade. Data for 1998, however, indicates there was one report of PV in the range of 50 to 100 million pounds, and that PV was reported for four additional PHDEs in that reporting year (CAS Nos. 32534-81-9, 32536-52-0, 58965-66-5, and 68928-80-3).

Industry identified three processing and use activities for PHDE substances in 2015, of which only one involved processing or use as a flame retardant. From industry reporting to EPA uses as a flame retardant included:

- Electrical equipment, appliance, and component manufacturing (1 report)

No reports identified either a consumer or consumer/commercial use or a children's product use for this chemical. This contrasts with product testing data found in the literature search and with reporting from the HPCDS, which indicate PHDEs are used in variety of consumer and children's products. Gaps

in information within the supply chain, however, may make it difficult for industry to know or reasonably ascertain if hazardous chemicals are or will be used in consumer or children's products.

Over the period 2015-2019, industry has submitted 98 reports each year under the Toxics Release Inventory (TRI) for CAS No. 1163-19-5. The use classification for the chemical was

- 3.2B: P201. Processing as a formulation component (Additives)
- 3.3A: Z199. Otherwise use as a chemical processing aid (Other)

TRI reports indicate the waste volume managed for this chemical fluctuated between about 146,000 and 517,000 pounds per year for 2016-2019.

Industries accounting for the most TRI reports include:

- Other Communication and Energy Wire Manufacturing (20 reports)
- Custom Compounding of Purchased Resins (14 reports)
- Copper Rolling, Drawing, Extruding, and Alloying (11 reports)

K.1.3 USE IN CONSUMER AND CHILDREN'S PRODUCTS

The states of Washington and Oregon require industry to report on chemicals of concern in products intended for use by children that are sold in those states. The reporting tool used by Washington and Oregon is known as the High Priority Chemicals Data System (HPCDS). According to data available from the HPCDS, manufacturers have reported the use of potentially hazardous PHDEs in children's products.

Over the period 2012-2020, 186 reports of PHDE use in children's products were submitted, all for decaBDE (CAS No. 1163-19-5). Of these, 91 reports indicated the chemical function in the product was "flame retardant" and eight of these reported the concentration in the final product exceeded 0.1 percent. Children's products falling into this group included: shoes - general purpose (3 reports), artists accessories (2 reports), outdoor play structures (2 reports), and role play - housekeeping/gardening/DIY toys (1 report).

DecaBDE was found in the following components in these products:

- Synthetic polymers (synthetic rubber, plastics, foams, etc.); and
- Textiles (synthetic fibers and blends).

According to the HPCDS, all reported uses of decaBDE in children's products at concentrations equal to or greater than 10,000 ppm were for flame retardant purposes (chemical function). DecaBDE at these concentrations was reported in the synthetic polymers of children's shoes and in textiles used in outdoor play structures.

PHDEs have been cited in 59 of 187 literature sources reviewed. Among the 45 PHDEs cited, chemicals appearing in the largest number of these include CAS Nos. 1163-19-5 (47 sources), 60348-60-9 (23 sources), 189084-64-8 (22 sources), 5436-43-1 (22 sources), 68631-49-2 (21 sources), 32536-52-0 (21 sources), and 32534-81-9 (19 sources). Several sources report the results of product testing, and these indicate PHDEs have been found in a variety of consumer and/or children's products, such as (reported concentrations in products shown in parentheses):

- Children's car seat foam/textiles:
    - 0.00000019 percent (CAS No. 41318-75-6)
    - 0.000000041 percent (CAS No. 5436-43-1)
    - 0.00000044 percent (CAS No. 243982-82-3)
- Hard and soft plastic, wooden, foam, textile toys: median
    - 0.0000001 percent (CAS No. 189084-64-8)
    - 0.000001 percent (CAS No. 68631-49-2)
    - 0.0000015 percent (CAS No. 207122-15-4)
    - 0.000002 percent (CAS No. 207122-16-5)
    - 0.000001 percent (CAS No. 5436-43-1)
    - 0.000001 percent (CAS No. 189084-61-5)
    - 0.0000001 percent (CAS No. 182346-21-0)
    - 0.000002 percent (CAS No. 60348-60-9)
    - Not detected (CAS No. 41318-75-6)
- Kitchen utensils, maximum:
    - 0.000011 percent (CAS No. 189084-64-8)
    - 0.012 percent (CAS No. 68631-49-2)
    - 0.0001 percent (CAS No. 207122-15-4)
    - 0.0013 percent (CAS No. 207122-16-5)
    - 0.000013 percent (CAS No. 41318-75-6)
    - 0.0001 percent (CAS No. 5436-43-1)
    - 0.000053 percent (CAS No. 60348-60-9)
- Television (0.0014 to 0.04 percent; CAS No. 207122-16-5)
- Small appliances (0.0021 to 0.17 percent; CAS No. 207122-16-5)
- Large appliances (not detected; CAS No. 207122-16-5)
- Electronic, other (0.0245 to 0.247 percent: CAS No. 207122-16-5)
- Plastic toy (not detected; CAS No. 207122-16-5)
- Plastic, other (0.017 percent; CAS No. 207122-16-5)
- Computer (0.0016 percent; CAS No. 207122-16-5)
- New and secondhand toys (mean 0.0011 percent; CAS No. 446255-39-6)
- Hard plastic toys (max 0.4232 percent, median 0.003 percent; CAS No. 1163-19-5)

- Rubik's cube (0.033 percent; CAS No. 1163-19-5)
- Toy gun (0.435 percent; CAS No. 1163-19-5)
- Spring car (0.1304 percent; CAS No. 1163-19-5)
- Spring car (0.0944 percent; CAS No. 1163-19-5)
- Car launcher (0.9226 percent; CAS No. 1163-19-5)
- Miniature car (0.0284 percent; CAS No. 1163-19-5)
- Miniature car (0.128 percent; CAS No. 1163-19-5)
- Spring gun (0.0212 percent; CAS No. 1163-19-5)
- Thermal cup (0.0779 percent; CAS No. 1163-19-5)
- Thermal cup (0.0775 percent; CAS No. 1163-19-5)
- Radio back panel (0.5119 percent; CAS No. 1163-19-5)

Uses for PHDEs identified through the literature review (as described in Chapter 3) include:

CAS No. 101-55-3: interior car foam, other interior car materials, curtains; assembly boards, IT devices, upholstered furniture, upholstered furniture, upholstered foams, mattresses, circuit boards.

CAS No. 1163-19-5: sofas, chairs, mattresses, car seats, pillows; electronics, textiles, children's toys, building insulation, electronics enclosures, tent fabrics, construction materials, flooring, food contact articles, carpet, thermo cups, hair clips, combs, kitchen utensils, textile backcoatings, fibers.

CAS No. 117948-63-7: furniture, electronics, textiles, children's toys, car interior foam, other car interior materials, curtains.

CAS No. 117964-21-3: car interior foam, other car interior materials, curtains, children's toys.

CAS No. 147217-75-2: upholstered furniture, electrical and electronic equipment, car interior foam, other car interior materials, curtains.

CAS No. 182346-21-0: children's toys, construction materials, electrical and electronic devices, flooring, fabric, upholstery, curtains, insulation, assembly boards, IT devices, mattresses, circuit boards, car interior foam, other car interior materials.

CAS No. 182677-30-1: household/office furniture/furnishings, baby care, home appliances, clothing, toys/games, electrical supplies, building products, communications, computing, camping gear, IT devices, upholstered furniture, mattresses, circuit boards, car interior foam, other car interior materials, curtains.

CAS No. 189084-60-4: insulation, assembly boards, IT devices, upholstered furniture, upholstery foams, mattresses, and circuit boards.

CAS No. 189084-61-5: children's toys, construction materials, electric and electronic devices, flooring, fabric, upholstery, household/office furniture/furnishings, baby care, home appliances, clothing, toys/games, electrical supplies, building products, communications, computing, camping gear, curtains, car interior foam, other car interior materials.

CAS No. 189084-62-6: upholstered furniture, electrical and electronic equipment, car interior foam, other car interior materials, curtains.

CAS No. 189084-64-8: furniture, electronics, textile, and children's toys, construction materials, electrical and electronic devices, flooring, fabric, upholstery, household/office furniture/furnishings, baby care, home appliances, clothing, toys/games, electrical supplies, building products, communications, computing, camping gear, curtains, electrical and electronic equipment, paper and textile adhesives, polyurethane and polystyrene foam, plastics, wires, baby mattresses, diaper-changing mats, feeding chairs, baths, aprons, assembly boards, kitchen utensils.

CAS No. 189084-66-0: car interior foam, other car interior materials, curtains.

CAS No. 189084-68-2: household/office furniture/furnishings, baby care, home appliances, clothing, toys/games, electrical supplies, building products, communications, computing, camping gear, insulation, assembly boards, IT devices, upholstered furniture, upholstery foams, mattresses, and circuit boards.

CAS No. 2050-47-7: car interior foam, other car interior materials, curtains.

CAS No. 207122-15-4: furniture, electronics, textile, children's toys, construction materials, electrical and electronic devices, flooring, fabric, upholstery, household/office furniture/furnishings, baby care, home appliances, clothing, building products, communications, computing, camping gear, curtains, electronics casings, paper, textile adhesives, polyurethane and polystyrene foam, plastics, car interior foam, other car interior materials, and kitchen utensils.

CAS No. 207122-16-5: furniture, electronics, textile, children's toys, construction materials, electrical and electronic devices, flooring, fabric, upholstery, household/office furniture/furnishings, baby care, home appliances, clothing, toys/games, electrical and electronic equipment, building products, communications, computing, camping gear, carpets, curtains, electronic equipment casings, building materials, paper and textile adhesives, polyurethane and polystyrene foam, car interior foam, other car interior materials, and kitchen utensils.

CAS No. 243982-82-3: furniture, electronics, textile, and children's toys, children's car seats, car interior foam, other car interior materials, and curtains.

CAS No. 32534-81-9: crib mattresses using polyurethane foam, furniture, electronics, textiles, children's toys, baby products, building materials, paper, textile adhesives, nursing pillows, strollers, baby carriers, car seats, and changing table pads.

CAS No. 32536-52-0: electronic appliances, furniture and upholstery, car interiors, and raw materials for electronics, electronics, textile, and children's toys, foam plastic building insulation, electronic enclosures, thermo cups, combs, headdresses, paper, textile adhesives, polyurethane and polystyrene foam.

CAS No. 366791-32-4: car interior foam, other car interior materials, curtains.

CAS No. 405237-85-6: car interior foam, other car interior materials, and curtains.

CAS No. 41318-75-6: furniture, electronics, textile, and children's toys, construction materials, flooring, upholstery, carpet, curtains, children's car seats, car interior foam, other car interior materials, and kitchen utensils.

CAS No. 437701-78-5: electronics, building materials, paper and textile adhesives, polyurethane and polystyrene foam, and plastics.

CAS No. 437701-79-6: electronics, building materials, paper and textile adhesives, polyurethane and polystyrene foam, plastics, car interior foam, other car interior materials, and curtains.

CAS No. 446255-30-7: car interior foam, other car interior materials, and curtains.

CAS No. 446255-39-6: car interior foam, other car interior materials, children's toys, and curtains.

CAS No. 446255-50-1: electronics, building materials, paper and textile adhesives, polyurethane and polystyrene foam, and plastics.

CAS No. 51892-26-3: car interior foam, other car interior materials, and curtains.

CAS No. 5436-43-1: electronics, textile, and children's toys, construction materials, electrical and electronic devices, flooring, fabric, upholstery, household/office furniture/furnishings, baby care, home appliances, clothing, toys/games, electrical supplies, building products, communications, computing, camping gear, curtain, carpet, electronic casings, paper and textile adhesives, polyurethane and polystyrene foam, children's car seats, mattresses, car interior foam, other car interior materials, and curtains, and kitchen utensils.

CAS No. 58965-66-5: curtains, polyester, wire, and cable.

CAS No. 60348-60-9: electronic appliances, furniture and upholstery, car interiors, sofas, chairs, mattresses, car seats, pillows, furniture, electronics, textile, and children's toys, foam plastic building insulation and electronics enclosures, construction materials, textiles, paper and textile adhesives, polyurethane and polystyrene foam, baby mattresses, diaper-changing mats, feeding chairs, baths, aprons, car interior foam, other car interior materials, curtains, and kitchen utensils.

CAS No. 63387-28-0: car interior foam, other car interior materials, and curtains.

CAS No. 68631-49-2: furniture, electronics, textile, children's toys, construction materials, electrical and electronic devices, flooring, fabric, upholstery, household/office furniture/furnishings, baby care, home appliances, clothing, toys/games, electrical supplies, building products, communications, computing, camping gear, carpet, curtains, car interior foam, other car interior materials, and kitchen utensils.

CAS No. 68928-80-3: clothes hangers.

CAS No. 93703-48-1: car interior foam, other car interior materials, and curtains.

K.2 PHDES ON NATIONAL AND INTERNATIONAL INVENTORIES AND REGISTRIES

Chemicals in class: 223

- 11 active on TSCA Inventory (recently manufactured/imported in U.S.)[26]
- 0 inactive on TSCA Inventory (no longer manufactured/imported in U.S.)
- 212 not on TSCA Inventory (never manufactured/imported in U.S.)

PHDES ON THE TSCA ACTIVE INVENTORY	
101-55-3	p-Bromodiphenyl ether
1163-19-5	1,1'-Oxybis[2,3,4,5,6-pentabromobenzene]
2050-47-7	4,4'-Dibromodiphenyl ether
32534-81-9	Pentabromodiphenyl ether
32536-52-0	Octabromodiphenyl ether
36483-60-0	Hexabromodiphenyl ether
40088-47-9	Tetrabromodiphenyl ether
49690-94-0	Tribromodiphenyl ether
58965-66-5	Perbromo-1,4-diphenoxybenzene
63936-56-1	Nonabromodiphenyl ether
68928-80-3	Diphenyl ether, heptabromo derivative
PHDES ON THE TSCA INACTIVE INVENTORY	
None	

OTHER PHDES ON INTERNATIONAL REGISTRIES		
7025-06-1	Benzene, bromophenoxy-	Japan CSCL
103173-66-6	1,1'-Oxybis(3,5-dibromobenzene)	Japan CSCL
116995-32-5	1,2,4,5-Tetrabromo-3-(2,4,6-tribromophenoxy)benzene	Japan CSCL
116995-33-6	BDE-147	Japan CSCL
117948-63-7	Benzene, 1,2,3,5-tetrabromo-4-(2,4,6-tribromophenoxy)-	Japan CSCL
147217-71-8	1-Bromo-2-(4-bromophenoxy)benzene	Japan CSCL
147217-72-9	BDE-6	Japan CSCL
147217-73-0	BDE-19	Japan CSCL
147217-74-1	1,2-Dibromo-3-(2-bromophenoxy)benzene	Japan CSCL
147217-75-2	2,2',4-Tribromodiphenyl ether	Japan CSCL
147217-76-3	BDE-20	Japan CSCL
147217-77-4	2,4-Dibromo-1-(3-bromophenoxy)benzene	Japan CSCL
147217-78-5	2',3,4-Tribromodiphenyl ether	Japan CSCL
147217-79-6	1,3-Dibromo-5-(3-bromophenoxy)benzene	Japan CSCL
147217-80-9	BDE-35	Japan CSCL
147217-81-0	BDE-37	Japan CSCL
155999-95-4	2,4,6-Tribromodiphenyl ether	Japan CSCL
171977-44-9	2,4-Dibromo-1-phenoxybenzene	Japan CSCL

[26] "Active" indicates that U.S. manufacturing or importing activity has been reported since June 2006.

OTHER PHDES ON INTERNATIONAL REGISTRIES		
189084-65-9	1,2,3,4,5-Pentabromo-6-phenoxybenzene	Japan CSCL
207122-15-4	2,2',4,4',5,6'-Hexabromodiphenyl ether	Japan CSCL
207122-16-5	2,2',3,4,4',5',6-Heptabromodiphenyl ether	Japan CSCL
35854-94-5	2,2',4,4',6,6'-Hexabromodiphenyl Ether	Japan CSCL
41318-75-6	2,4,4'-Tribromodiphenyl ether	Japan CSCL
41424-36-6	1,3,5-Tribromo-2-methoxy-4-methylbenzene	Canada DSL
446255-22-7	BDE-175	Japan CSCL
51452-87-0	BDE-4	Japan CSCL
51930-04-2	Benzene, 1,3-dibromo-2-phenoxy-	Japan CSCL
53563-56-7	Diphenyl ether, dibromo-	Japan CSCL
5436-43-1	2,2',4,4'-Tetrabromodiphenyl ether	Japan CSCL
60348-60-9	2,2',4,4',5-Pentabromodiphenyl ether	Japan CSCL
65075-08-3	1,4-Dibromo-2-(4-bromophenoxy)benzene	Japan CSCL
68631-49-2	2,2',4,4',5,5'-Hexabromodiphenyl ether	Japan CSCL
6876-00-2	PBDE 002	Japan CSCL
6903-63-5	1,1'-Oxybis(3-bromobenzene)	Japan CSCL
83694-71-7	1-Bromo-3-(4-bromophenoxy)benzene	Japan CSCL
93703-48-1	BDE-77	Japan CSCL

K.3 U.S. MANUFACTURING AND IMPORTING ACTIVITY, 2015

NUMBER OF REPORTS BY ACTIVITY TYPE						
PHDES	MANUFACTURE	IMPORT	BOTH MANUFACTURE AND IMPORT	NOT SPECIFIED	CBI	TOTAL
1163-19-5		1		2	2	5

Source: U.S. EPA, CDR (2016).

K.4 U.S. MANUFACTURING AND IMPORTING VOLUMES, 2015

REPORTED VOLUMES BY ACTIVITY TYPE					
PHDES	MANUFACTURE	IMPORT	PRODUCTION VOLUME (MANUFACTURE + IMPORT)	USED	EXPORTED
1163-19-5	-	573,192	573,192	529,100	-

-- data CBI or otherwise not disclosed
Source: U.S. EPA, CDR (2016).

K.5 U.S. PRODUCTION VOLUME TRENDS, 2012-2015

PHDES	PV 2015	PV 2014	PV 2013	PV 2012
1163-19-5	573,192	284,330	275,413	64,167

-- data CBI or otherwise not disclosed
PV = manufacturing plus importing
Source: U.S. EPA, CDR (2016).

K.6 TYPE OF PROCESSING OR USE REPORTS, 2015

NUMBER OF REPORTS								
PHDES	Processing as a Reactant	Processing—Incorporation Into Article	Processing—Incorporation Into Formulation, Mixture, or Reaction Product	Processing—Repackaging	Use—Non-Incorporative Activities	CBI	NKRA	Grand Total
1163-19-5		1	2					3

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

K.7 INDUSTRIAL USE REPORTS, 2015

NUMBER OF REPORTS																							
PHDES	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
1163-19-5																	1			2				3
USED AS FLAME RETARDANT																								
1163-19-5																	1			2				3

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

K.8 INDUSTRIAL FUNCTION REPORTS, 2015

NUMBER OF REPORTS															
PHDES	Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Other	Paint Additives and Coating Additives Not Described By Other Categories	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	CBI	NKRA	Grand Total
1163-19-5				3											3

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

K.9 INDUSTRIAL SECTOR REPORTS, 2015

NUMBER OF REPORTS: POLYHALOGENATED DIPHENYL ETHERS																							
PHDE	Adhesive Manufacturing	All Other Basic Inorganic Chemical	All Other Basic Organic Chemical	All Other Chemical Product and Preparation	Computer and Electronic Product	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural	Petroleum Lubricating Oil and Grease	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
ALL INDUSTRIAL FUNCTIONS																							
Total																	1			2				3
1163-19-5																	1			2				3
USED AS FLAME RETARDANT																							
Total																	1			2				3
1163-19-5																	1			2				3

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

K.10 CONSUMER AND CHILDREN'S PRODUCT USE REPORTS, 2015

NUMBER OF REPORTS						
PHDES	COMMERCIAL	CONSUMER	CONSUMER AND COMMERCIAL	NKRA	CBI	TOTAL
None						

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

PHDES	CHILDREN'S PRODUCT USE	NKRA	OTHER USE	TOTAL
None				

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

K.11 TOXIC RELEASE INVENTORY REPORTS

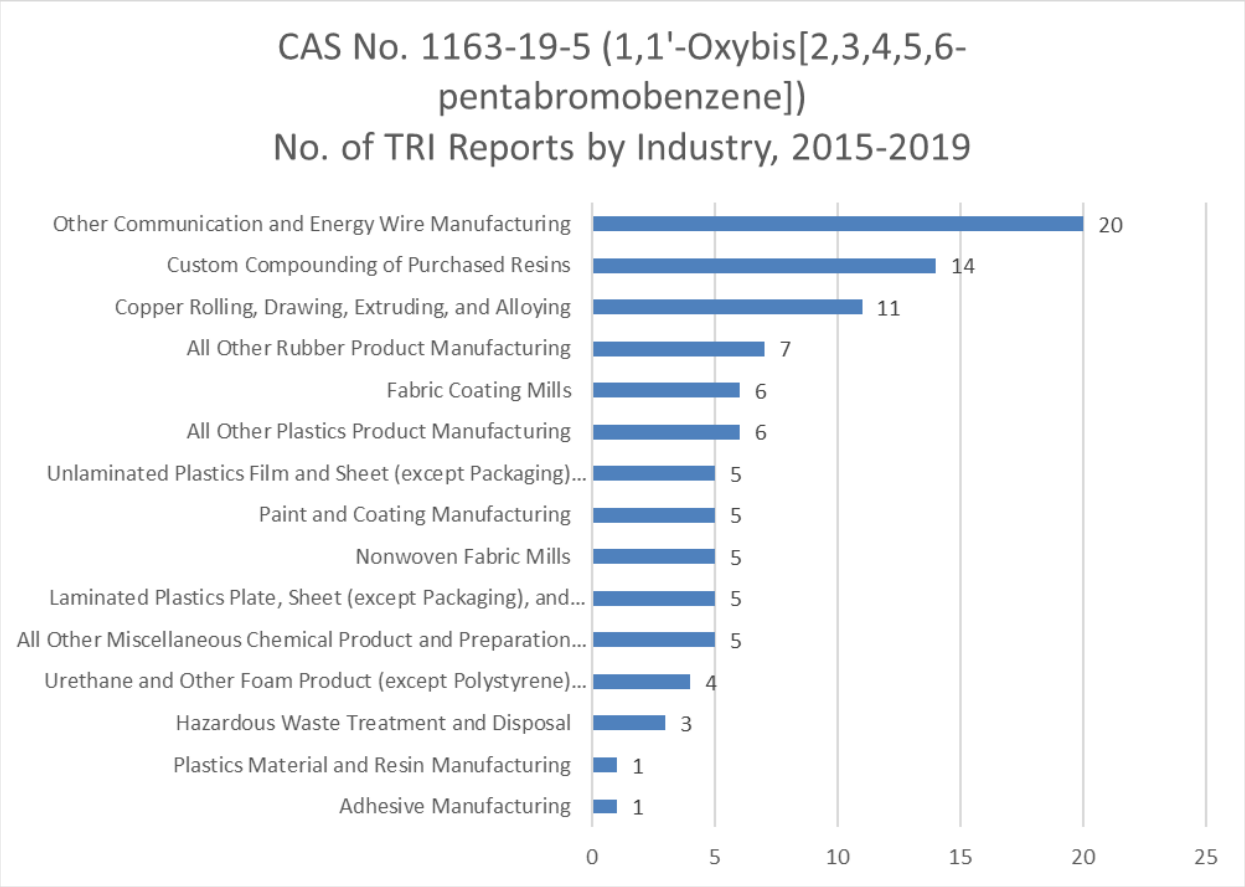
TRI-REPORTABLE CHEMICALS	
1163-19-5	1,1'-Oxybis[2,3,4,5,6-pentabromobenzene]

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TOTAL PRODUCTION-RELATED WASTE REPORTED							
PHDES		2015	2016	2017	2018	2019	TOTAL
1163-19-5	No. of Reports	30	24	17	16	11	98
	Pounds of waste managed	463,003	517,297	250,060	155,428	146,017	1,531,805

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TRI REPORTS BY INDUSTRY



Source: U.S. EPA, Toxics Release Inventory (2015-2019).

K.12 HIGH PRIORITY CHEMICALS DATA SYSTEM REPORTS

NUMBER OF REPORTS BY YEAR											
PHDES		2012	2013	2014	2015	2016	2017	2018	2019	2020[1]	TOTAL
1163-19-5	TOTAL	1	7	27	10	30	82	8	17	4	186
	FR	1	1	6	4	3	66	3	7		91
	CONC > 0.1 PERCENT			1	1	1		2	3		8

[1] Partial year reporting.
Source: Interstate Chemicals Clearinghouse, (2021).

Products with FR concentrations > 0.1 percent include: artists accessories, outdoor play structures, role play (housekeeping/gardening/DIY toys), and shoes.

K.13 PATENT COUNTS FROM PUBCHEM

		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
101-55-3	7565	96	631	926	**1,653**	6	2	8	**16**	1	2	1	**4**
1163-19-5	14410	852	8,362	19,390	**28,604**	367	3,082	7,109	**10,558**	241	2,052	3,916	**6,209**
2050-47-7	16305	51	555	864	**1,470**	4	14	51	**69**	4	7	25	**36**
5436-43-1	95170	5	3	206	**214**	2	1	9	**12**	2	1	7	**10**
6876-00-2	96165	21	128	244	**393**	0	0	0	**0**	0	0	0	**0**
6903-63-5	13283773	8	56	31	**95**	0	0	0	**0**	0	0	0	**0**
7025-06-1	37483	21	248	667	**936**	2	47	150	**199**	2	40	121	**163**
32536-52-0	6537506	141	1,320	3,397	**4,858**	53	507	1,350	**1,910**	39	317	831	**1,187**
32577-34-7	5235675	0	24	96	**120**	0	16	49	**65**	0	5	15	**20**
35854-94-5	11028658	14	10	49	**73**	6	5	41	**52**	5	4	37	**46**
36065-30-2	118274	1	0	0	**1**	0	0	0	**0**	0	0	0	**0**
38463-82-0	71446569	1	0	0	**1**	0	0	0	**0**	0	0	0	**0**
41318-75-6	12110098	0	8	23	**31**	0	0	0	**0**	0	0	0	**0**
41424-36-6	5067511	0	5	0	**5**	0	0	0	**0**	0	0	0	**0**
46438-88-4	17921073	1	59	17	**77**	0	0	0	**0**	0	0	0	**0**
49690-94-0	39506	40	61	60	**161**	30	38	25	**93**	27	16	18	**61**
51452-87-0	3465096	13	66	294	**373**	0	10	54	**64**	0	6	25	**31**
51892-26-3	92339	4	60	64	**128**	0	0	0	**0**	0	0	0	**0**
51930-04-2	12073147	0	0	1	**1**	0	0	0	**0**	0	0	0	**0**
53563-56-7	185745	4	14	51	**69**	0	1	5	**6**	0	1	3	**4**
58965-66-5	100907	0	5	42	**47**	0	3	24	**27**	0	3	12	**15**
60348-60-9	36159	4	2	137	**143**	1	0	10	**11**	0	0	6	**6**
63387-28-0	45472	9	58	165	**232**	4	16	58	**78**	1	11	22	**34**
63936-56-1	45472	9	58	165	**232**	4	16	58	**78**	1	11	22	**34**
67797-09-5	3290414	0	0	1	**1**	0	0	0	**0**	0	0	0	**0**
68631-49-2	155166	1	0	88	**89**	0	0	3	**3**	0	0	1	**1**
68928-80-3	3034400	10	32	69	**111**	2	7	13	**22**	1	4	7	**12**
79755-43-4	3086109	0	9	42	**51**	0	0	5	**5**	0	0	1	**1**

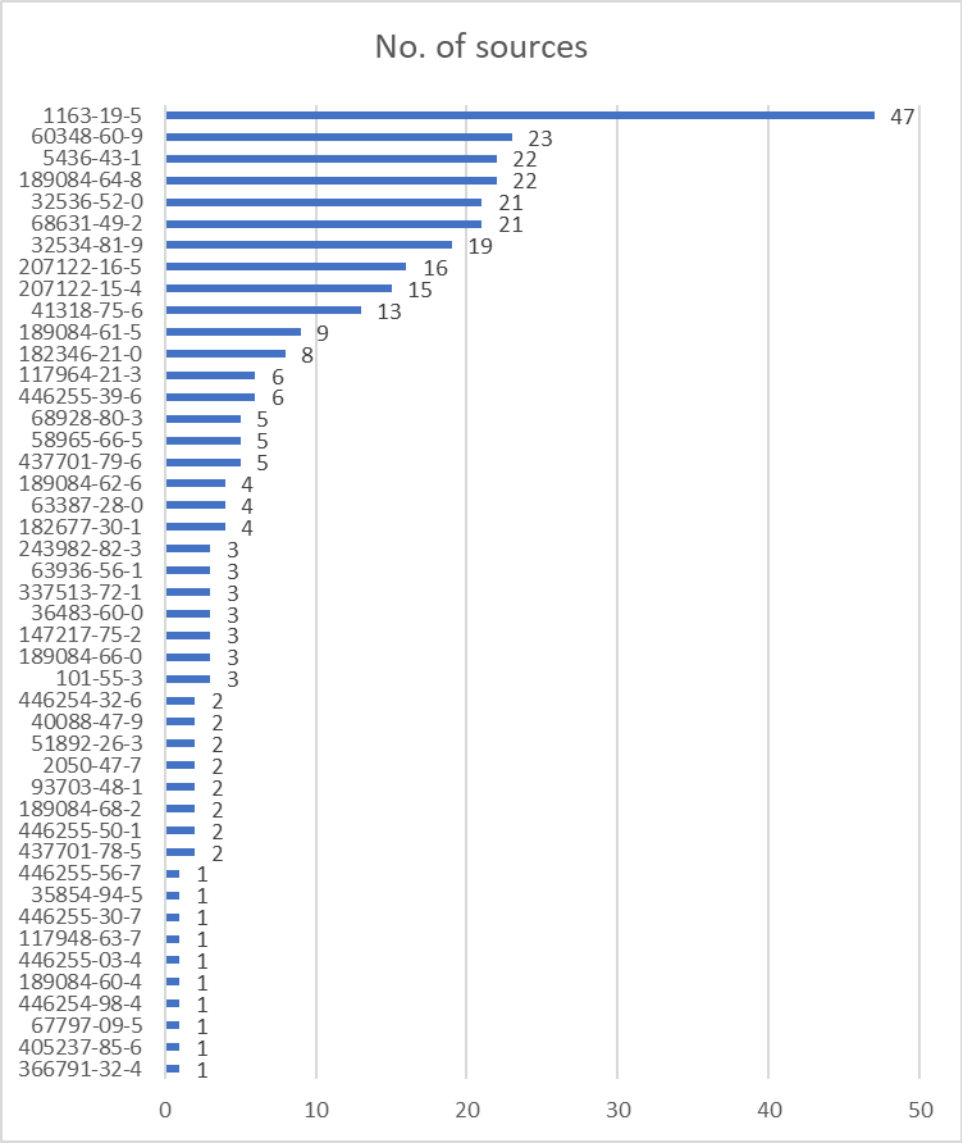
		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
83694-71-7	15738105	6	31	19	**56**	0	0	0	**0**	0	0	0	**0**
85446-17-9	6537506	141	1,320	3,397	**4,858**	53	507	1,350	**1,910**	39	317	831	**1,187**
93703-48-1	13283771	0	1	19	**20**	0	0	1	**1**	0	0	1	**1**
103173-66-6	53987846	0	1	2	**3**	0	0	0	**0**	0	0	0	**0**
117948-63-7	10930591	0	0	8	**8**	0	0	0	**0**	0	0	0	**0**
117964-21-3	11967214	0	0	11	**11**	0	0	2	**2**	0	0	0	**0**
147217-71-8	15738106	4	5	25	**34**	0	1	0	**1**	0	1	0	**1**
147217-72-9	15738107	1	1	4	**6**	0	0	1	**1**	0	0	0	**0**
147217-75-2	14274807	0	0	10	**10**	0	0	0	**0**	0	0	0	**0**
147217-78-5	39506	40	61	60	**161**	30	38	25	**93**	27	16	18	**61**
147217-81-0	12073152	0	0	1	**1**	0	0	0	**0**	0	0	0	**0**
155999-95-4	12073149	0	2	4	**6**	0	0	0	**0**	0	0	0	**0**
171977-44-9	14942774	2	3	3	**8**	0	0	1	**1**	0	0	0	**0**
182346-21-0	177368	0	0	49	**49**	0	0	2	**2**	0	0	1	**1**
182677-28-7	13828347	8	15	22	**45**	2	10	9	**21**	2	8	8	**18**
182677-30-1	15254861	0	0	15	**15**	0	0	1	**1**	0	0	1	**1**
189084-59-1	12073146	2	1	1	**4**	0	0	0	**0**	0	0	0	**0**
189084-61-5	15509893	0	0	17	**17**	0	0	0	**0**	0	0	0	**0**
189084-62-6	15509894	0	0	19	**19**	0	0	0	**0**	0	0	0	**0**
189084-63-7	15509895	0	0	3	**3**	0	0	0	**0**	0	0	0	**0**
189084-64-8	154083	0	19	74	**93**	0	0	5	**5**	0	0	2	**2**
189084-65-9	13766702	160	571	1,884	**2,615**	71	264	488	**823**	49	160	275	**484**
189084-66-0	15509897	0	0	18	**18**	0	0	1	**1**	0	0	1	**1**
189084-68-2	12110099	0	0	2	**2**	0	0	0	**0**	0	0	0	**0**
207122-15-4	15509898	0	0	104	**104**	0	0	4	**4**	0	0	2	**2**
207122-16-5	15509899	0	0	71	**71**	0	0	4	**4**	0	0	2	**2**
243982-82-3	15509892	0	0	41	**41**	0	0	0	**0**	0	0	0	**0**
337513-66-3	54331028	0	1	15	**16**	0	0	0	**0**	0	0	0	**0**
337513-67-4	12073148	0	17	26	**43**	0	9	11	**20**	0	7	7	**14**
337513-72-1	36160	19	918	1,563	**2,500**	11	403	574	**988**	6	275	264	**545**
337513-77-6	18769358	3	82	103	**188**	0	8	20	**28**	0	4	13	**17**

		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
366791-32-4	15509896	0	0	6	**6**	0	0	0	**0**	0	0	0	**0**
405237-85-6	71363340	0	0	9	**9**	0	0	0	**0**	0	0	0	**0**
437701-78-5	14149410	0	4	4	**8**	0	2	1	**3**	0	2	1	**3**
437701-79-6	11018364	0	0	7	**7**	0	0	0	**0**	0	0	0	**0**
442690-45-1	85823923	0	0	7	**7**	0	0	0	**0**	0	0	0	**0**
446254-15-5	86208485	0	0	1	**1**	0	0	1	**1**	0	0	1	**1**
446254-24-6	19792406	0	4	1	**5**	0	0	0	**0**	0	0	0	**0**
446254-26-8	13828345	0	24	26	**50**	0	6	10	**16**	0	0	6	**6**
446254-31-5	38386	11	135	585	**731**	4	73	197	**274**	2	52	85	**139**
446254-32-6	13766701	1	86	125	**212**	0	31	29	**60**	0	22	12	**34**
446254-39-3	86208511	0	10	0	**10**	0	0	0	**0**	0	0	0	**0**
446254-80-4	57358122	0	0	1	**1**	0	0	0	**0**	0	0	0	**0**
446254-81-5	86208551	0	0	2	**2**	0	0	0	**0**	0	0	0	**0**
446254-95-1	86208452	0	0	1	**1**	0	0	0	**0**	0	0	0	**0**
446254-98-4	13766703	11	172	201	**384**	4	51	84	**139**	2	35	42	**79**
446255-03-4	37454	15	182	110	**307**	7	51	40	**98**	3	35	18	**56**
446255-30-7	53485723	0	0	8	**8**	0	0	0	**0**	0	0	0	**0**
446255-38-5	13847957	18	502	1,436	**1,956**	8	210	494	**712**	3	141	340	**484**
446255-39-6	71363036	0	0	18	**18**	0	0	1	**1**	0	0	1	**1**
446255-46-5	72941821	0	0	1	**1**	0	0	0	**0**	0	0	0	**0**
446255-50-1	72941822	0	0	2	**2**	0	0	0	**0**	0	0	0	**0**
446255-54-5	53485722	0	0	2	**2**	0	0	0	**0**	0	0	0	**0**
446255-56-7	16212145	0	0	4	**4**	0	0	1	**1**	0	0	1	**1**

Of the 223 PHDEs, 143 chemicals returned no patent records from PubChem and have been omitted from this table.
Source: PubChem Patent Data (See Exhibit 2-1 in main report and on OFR_universe_wPCPy_10122021.xlsx, tab 'Patent Info by CID' in Supplemental Information)

K.14 PHDES CITED IN LITERATURE REVIEW

A literature search was conducted to identify sources with information about chemicals in this OFR class (see Chapter 3). PHDEs are mentioned or referenced in 59 of the 187 sources reviewed.



In this section, the following OECD use codes for chemicals are listed according to the internationally harmonized functional, product and article use categories[27]:

[27] Source: OECD (2017).

- AC2a. Complex articles. Machinery, mechanical appliances, electrical/electronic articles. Examples: Refrigerators, washing machines, vacuum cleaners, computers, telephones, drills, saws, smoke detectors, thermostats, radiators.
- AC2a. Complex articles. Machinery, mechanical appliances, electrical/electronic articles. Examples: Refrigerators, washing machines, vacuum cleaners, computers, telephones, drills, saws, smoke detectors, thermostats, radiators..
- AC4a. Stone, plaster, cement, glass and ceramic articles. Construction and building materials covering large surface areas. Examples: Cement flooring, Cement flooring, stone tile, mirrors, sinks, bathtubs.
- AC5b. Fabrics, textiles, and apparel. Toys intended for children's use (and child dedicated articles). Examples: stuffed toys, blankets, comfort objects.
- AC5e. Fabrics, textiles, and apparel. Furniture & furnishings, including furniture coverings. Examples: Sofa cover, car seat cover, fabric chair, hammock.
- AC10d. Rubber articles. Articles intended for food contact. Examples: Plates, utensils.
- AC13b. Plastic articles (hard). Toys intended for children's use (and child dedicated articles). Examples: Toys (dolls, car, animals, teething rings).
- AC13d. Plastic articles (hard). Articles intended for food contact. Examples: Plastic dinner ware, food storage.
- AC13e. Plastic articles (hard). Furniture & furnishings, including furniture coverings. Examples: Computer casing.
- AC13f. Plastic articles (hard). Other articles with routine direct contact during normal use. Examples: Handles, pencils, handheld device casing.
- AC14b. Plastic articles (soft). Toys intended for children's use (and child dedicated articles). Examples: Toys (dolls, car, animals).
- AC14e. Plastic articles (soft). Furniture & furnishings, including furniture coverings. Examples: Foam armchair, couch/sofa, mattress adult, mattress infant, mattress child, sleeping bag, beanbag chair.
- AC14f. Plastic articles (soft). Other articles with routine direct contact during normal use. Examples: Foam blocks used in foam block pits.

K.14.1 1163-19-5 1,1'-OXYBIS[2,3,4,5,6-PENTABROMOBENZENE]

- This chemical was referenced in 47 sources
    - Plastic kitchen utensils: <2.6 to 14,0000 ng/g (<0.0000001 to 0.01 percent)
    - Hard plastic toys: median 0.00343 percent, maximum 0.4232 percent
    - Rubik's cubes: 0 to 672 ppm (0 to 0.67 percent)
    - CRT TV wipe samples: geomean 5800 ng/wipe, maximum 62,856 ng/wipe.
    - Television casings: mean of 0.000799 percent (range ND-0.004565 percent), computer display casings mean of 0.0001527 percent (range ND-0.0006080 percent), computer components mean of 0.0253992 percent (range ND-0.1607010 percent), car interiors

mean of 0.0007951 percent (range ND- 0.0034609 percent), raw materials mean of 0.0108926 percent (range ND-0.06773331 percent).
    - New and secondhand children's toys: mean concentration of 0.016 percent
    - Television: 0.0011 to 8.86 percent, small household appliances: 0.0044 - 0.505 percent, large household appliances 0.0012 to 0.011 percent, other electronics: 0.168 - 1.8 percent, plastic toys: 0.015 to 14.3 percent, other plastics 0.89 percent, computer 0.132 percent
    - Rubik's cube: 0.033 percent, toy gun 0.435 percent, spring car 0.1304 percent, second spring car 0.0944 percent, car launcher 0.9226 percent, miniature car 0.0284 percent, second miniature car 0.128 percent, spring gun 0.0212 percent, thermal cup 0.0779 percent, second thermal cup 0.0775 percent, radio back panel 0.5119 percent
    - Synthesis of 37 papers found that DecaBDE had a mean concentration of 0.52 percent in waste electronic and electrical equipment, 0.31 percent in vehicles, 0.866 percent in construction materials, 0.65 percent in textiles and upholstery, was not detected in non-food packaging, 0.0084 percent in large household appliances, cooling and freezing appliances, and 0.599 percent in other categories
    - Sample of hard plastic, soft plastic, wooden, foam and textile toys: median of 0.0000075 percent
    - Tent wipe samples: median of 0.00000253 percent
    - Computer motherboard: 1.158 percent, window blind 0.4799 percent, upholstery 0.0007023 percent
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0001172388 to 0.060136069 percent
    - Plastic shredders: 0.18 percent and 0.26 percent, plastic pallet: 0.24 percent carpet padding foam: 0.02 percent and 0.014 percent
    - Television cabinets: flame retarded with 11.5 percent DecaBDE
    - Smart phones: not detected
    - Mobile phone wipe sample: 97 percent of samples (median 7.6 pg/cm^2), computer wipe samples: 100 percent of samples (median 7.6 pg/cm^2)

- 20 sources cited use in consumer products (tent fabrics; electrical and electronic devices; upholstered furniture; electronic device casings; mobile phones and computers; televisions and computers) and six sources cited use in children's products (toys)
- 24 sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC4a, AC5e, AC10d, AC13b, AC13d, AC13e, AC14b, and AC14e
- Multiple sources estimate global production at over 1 million tonnes per year (high production volume)
- According to these sources, this chemical has been used in: housings and internal components of TVs, mobile phones and fax machines, audio and video equipment, remote controls, communications cables, capacitor films, building cables, wire and cable, e.g., heat shrinkable tubes, connectors in electrical and electronic equipment, circuit breakers, coils of bobbins (i.e., for use in transformers), printing and photocopy machine components (e.g., plastic housing for toner cartridges), scanner components; thermoplastic outer casings for IT and TV appliances, textiles; thermoplastic resins, thermoset resins, textiles and adhesives.

- Two sources mentioned this chemical in the context of use trends, five sources mentioned substitutes, 10 mentioned end of life issues, and 29 mentioned laws or regulations

K.14.2 60348-60-9 2,2',4,4',5-PENTABROMODIPHENYL ETHER

- This chemical was referenced in 23 sources
- 16 sources mentioned product testing data and 12 included concentration data:
    - Kitchen utensils: <0.2 - 530 ng/g
    - TV casings: mean 0.000000681 percent (range ND-0.0000032 percent); computer display casings: mean 0.000000585 percent (range ND-0.00000159 percent); raw materials: mean 0.0001799 percent (range ND-0.0017964 percent).
    - New and secondhand toys: present across all samples at a mean concentration of 0.000059 percent
    - Sample of hard plastic, soft plastic, wood and foam toys: median of 0.000002 percent
    - Carpet padding foam: 0.0250 percent and 0.03 percent
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): all non-detect
    - Smart phones: not detected
- Eight sources cited use in consumer products (PUF from sofas, chairs, mattresses; electrical and electronic equipment) and four sources cited use in children's products (toys)
- Eleven sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC4a, AC5e, AC10d, AC14b, AC14e, AC14f
- No source provided data on production volume.
- According to these sources, this chemical has been used in: baby textiles, soft non-PVC toys, baby mattresses, diaper-changing mats, feeding chairs, baths, aprons.
- One source mentioned this chemical in the context of substitutes, five mentioned end of life issues, and 11 mentioned laws or regulations.

K.14.3 189084-64-8 2,2',4,4',6-PENTABROMODIPHENYL ETHER

- This chemical was referenced in 22 sources
- Twelve sources mentioned product testing data and nine included concentration data:
    - Kitchen utensils: <0.2 - 110 ng/g (< 0.00001 percent)
    - Television casings: mean of 0.000000030 percent (non-detect to 0.000000192 percent)
    - Computer display casings: mean of 0.000000019 percent (non-detect to 0.000000077 percent)
    - Raw materials: mean of 0.0000312 percent (non-detect to 0.0003122 percent).
    - New and secondhand toys: present across all samples at a mean concentration of 0.000012 percent
    - Sample of hard plastic, soft plastic, wood and foam toys: median of 0.0000001 percent
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000000015 to 0.0000001712 percent
    - Smart phones: not detected

- Five sources cited use in consumer products (flooring, fabric, upholstery; electrical and electronic equipment; appliances; window treatments) and three sources cited use in children's products (toys)
- Seven sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC4a, AC5e, AC10d, AC14b, AC14e, AC14f
- Two sources estimate global production at over 1 million tons per year (high production volume)
- According to these sources, this chemical has been used in: baby textiles, soft non-PVC toys, baby mattresses, diaper-changing mats, feeding chairs, baths, aprons.
- One source mentioned this chemical in the context of end of life issues, and one mentioned laws or regulations

K.14.4 5436-43-1 2,2',4,4'-TETRABROMODIPHENYL ETHER

- This chemical was referenced in 22 sources
- Thirteen sources mentioned product testing data and eleven included concentration data:
    - Kitchen utensils: <0.2 - 1000 ng/g (<0.0001 percent)
    - Median combined concentration of foam, fabric, and composition: 0.000000041 percent
    - TV casings: mean 0.00000128 percent (range ND to 0.00000718 percent); computer display casings: mean 0.000000261 percent (range ND to 0.000000642 percent); raw materials: mean of 0.0000977 percent (range ND to 0.0009740 percent).
    - New and secondhand toys: present across all samples at a mean concentration of 0.000042 percent
    - Sample of hard plastic, soft plastic, wood, and foam toys: median of 0.000001 percent
    - Computer motherboard: 0.0001173 percent
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): all non-detect
    - Carpet padding foam: 0.015 percent, 0.015 percent, and 0.011 percent
- Seven sources cited use in consumer products (electrical and electronic devices, flooring, fabric, upholstery; casings for electronic devices) and three sources cited use in children's products (toys; car seats)
- Nine sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC4a, AC5b, Ac5e, AC10d, AC14e, AC14f
- No source provided data on production volume.
- According to these sources, this chemical has been used in: electronics, building materials, paper and textile adhesives, polyurethane and polystyrene foam, and plastics.
- Four sources mentioned this chemical in the context of end of life issues, and eight mentioned laws or regulations

K.14.5 68631-49-2 2,2',4,4',5,5'-HEXABROMODIPHENYL ETHER

- This chemical was referenced in 21 sources
- Eleven sources mentioned product testing data and nine included concentration data:
    - Kitchen utensils: <0.4 – 120,000 ng/g (up to 0.012 percent)

  - TV casings: mean 0.000000042 percent (range ND-0.000000262 percent); computer display casings: mean 0.000000175 percent (range ND-0.000000699 percent); raw materials: mean of 0.0019608 percent (range ND-0.0195568 percent)
  - New and secondhand toys: present across all samples at a mean concentration of 0.0011 percent
  - Sample of hard plastic, soft plastic, wood and foam toys: median of 0.000001 percent
  - Computer motherboard: 0.0000259 percent
  - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000000018 to 0.0000003004 percent
  - Smart phones: not detected

- Six sources cited use in consumer products (electrical and electronic devices; flooring, fabric, upholstery; sofas, chairs, mattresses) and two cited use in children's products (toys)
- Nine sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC4a, AC5e, AC10d, AC10e, AC14f
- No source provided data on production volume.
- According to these sources, primary uses have included PU foam and in printed circuit boards.
- Four sources mentioned this chemical in the context of end of life issues, and seven mentioned laws or regulations

K.14.6 32536-52-0 OCTABROMODIPHENYL ETHER

- This chemical was referenced in 21 sources
- Two sources mentioned product testing data and two included concentration data:
  - TV casings: detected in 58.3 percent of samples with mean and maximum concentrations of 566 ng/g and 15,107 ng/g (< 0.01 percent)
  - Electronics raw materials (ABS/HIPS/PP/PBT resins): detected in 90.9 percent of raw materials at 215 to 1,336,230 ng/g (high of 0.13 percent)
  - Rubik's cubes: 0 to 1174 ppm (0.117 percent)
- Four sources cited use in consumer products (PUF from sofas chairs, mattresses, pillows; computer monitors) and one source cited use in children's products (toys)
- Eight sources reported human or environmental exposure data
- OECD use codes for this chemical included AC13e, AC13f, AC14b, AC14e
- One source estimates that from 2007 to 2016, global production was 5,290 tons (high production volume), but had declined to 447 tons (medium production volume) in 2016.
- Sources indicate the chemical was used in ABS, thermoplastics, polycarbonates, and coatings but has been phased out. Uses included computer monitors, TVs, appliances, and other related electronic devices.
- One source mentioned this chemical in the context of use trends, two sources mentioned substitutes, two mentioned end of life issues, and 12 mentioned laws or regulations

K.14.7 32534-81-9 PENTABROMODIPHENYL ETHER

- This chemical was referenced in 19 sources
- Two sources mentioned product testing data and three included or referenced concentration data:

  - Foam from baby products: present at > 1 percent in 5 samples, mean concentration of 3 percent
  - Testing of 174 item parts from 70 childcare items with potentially high oral or dermal exposure (children's jewelry items, toys, diaper-changing mats, baby mattresses, baby textiles, feeding and bathing items): not detected.

- Six sources cited use in consumer products (furniture; carpet backing, fabrics; furniture foam) and four cited use in children's products (car seats, strollers, changing table pads; baby products)
- Six sources reported human or environmental exposure data
- OECD use codes for this chemical included AC5b, AC14b, AC14e
- Though use widely through the early 2000s, production has been largely phased out
- According to these sources, until recently the chemical was used widely in manufacturing flexible PUF, with applications in furniture, curtains, and juvenile products. Penta-BDE was also once used in PVC, neoprene, wire and cable insulation, carpet backing, coated fabrics, and wall coverings, but has been phased out.
- Two sources mentioned this chemical in the context of use trends, six mentioned substitutes, end of life issues, and six mentioned laws or regulations.

K.14.8 207122-16-5 2,2',3,4,4',5',6-HEPTABROMODIPHENYL ETHER

- This chemical was referenced in 16 sources
- Ten sources mentioned product testing data and eight included concentration data:
  - TV casings: mean 0.0000131 percent (range ND to 0.0000772 percent); computer display casings: mean 0.0000578 percent (range ND to 0.0002302 percent); car interiors: mean 0.00000187 percent (range ND to 0.00000509 percent); raw materials: mean of 0.0133803 percent (range ND to 0.1313392 percent).
  - TV: 0.0014 - 0.04 percent; small appliances: 0.0021 to 0.17 percent; large appliances: not detected; other electronic: 0.0245 to 0.247 percent; plastic toy: not detected; other plastic: 0.017 percent; computer: 0.0016 percent
  - Sample of hard plastic, soft plastic, wood and foam toys: median 0.000002 percent
  - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000000354 to 0.0000000354 percent
  - Plastic shredders: 0.019 percent and 0.031 percent
  - Smart phones: not detected

- Five sources cited use in consumer products (electrical and electronic devices; flooring, fabric, upholstery; electronic appliances, furniture; window treatments) and one cited use in children's products (toys)
- Eight sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC4a, AC5e, AC10d, AC14e
- No source provided data on production volume.
- According to these sources, this chemical has been used in: building materials, textiles, plastics and electronic equipment.
- Four sources mentioned this chemical in the context of end of life issues, and six mentioned laws or regulations

K.14.9 207122-15-4 2,2',4,4',5,6'-HEXABROMODIPHENYL ETHER

- This chemical was referenced in 15 sources
- Eleven sources mentioned product testing data and eight included concentration data:
    - Kitchen utensils: <0.4 to 1,000 ng/g (≤ 0.0001 percent)
    - Sample of hard plastic, soft plastic, wood, and foam toys: median 0.0000015 percent
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000000044 to 0.0000000184 percent
    - Smart phones: not detected
- Five sources cited use in consumer products (electrical and electronic devices, flooring, fabric, upholstery; casings of electronic devices; appliances, furniture; window treatments) and one cited use in children's products (toys)
- Five sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC4a, AC5e, AC10d, AC14e, AC14f
- No source provided data on production volume.
- According to these sources, this chemical has been used in: electronics, building materials, paper and textile adhesives, polyurethane and polystyrene foam, and plastics.
- Four sources mentioned this chemical in the context of end of life issues and five mentioned laws or regulations

K.14.10 41318-75-6 2,4,4'-TRIBROMODIPHENYL ETHER

- This chemical was referenced in 13 sources
- Ten sources mentioned product testing data and eight included concentration data:
    - Kitchen utensils <0.4 to 1,000 ng/g (≤ 0.0001 percent)
    - TV casings: mean 0.000000091 percent (range ND to 0.000000544 percent); computer display casings: mean 0.000000225 percent (range ND to 0.000000452 percent); raw materials: mean of 0.0002463 percent (range ND to 0.0024575 percent)
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000000045 to 0.000000173 percent
    - Smart phones: not detected
- Five sources cited use in consumer products (casings of electronic devices; flooring, fabrics, upholstery; furniture foam) and one cited use in children's products (car seats)
- Five sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC4a, AC5b, AC5e, AC10d, AC14e, AC14f
- No source provided data on production volume.
- According to these sources, this chemical has been used in: building materials, textiles, plastics and electronic equipment.
- Four sources mentioned this chemical in the context of end of life issues, and five mentioned laws or regulations

K.14.11 189084-61-5 2,3',4,4'-TETRABROMODIPHENYL ETHER

- This chemical was referenced in nine sources
- Seven sources mentioned product testing data and six included concentration data:

  - TV casings: mean 0.000000503 percent (range ND to 0.00000239 percent)
  - Sample of hard plastic, soft plastic, wood, and foam toys: median 0.000001 percent
  - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000000121 to 0.0000025015 percent
  - Smart phones: not detected

- Three sources cited use in consumer products (electrical and electronic devices, flooring, fabric, upholstery; window treatments) and one cited use in children's products (toys)
- Three sources reported human or environmental exposure data
- OECD use codes for this chemical included AC4a, AC5e, AC14f
- No source provided data on production volume.
- According to these sources, this chemical has been used in: electronics, building materials, paper and textile adhesives, polyurethane and polystyrene foam, and plastics
- Three sources mentioned this chemical in the context of end of life issues, and one mentioned laws or regulations

K.14.12 182346-21-0 2,2',3,4,4'-PENTABROMODIPHENYL ETHER

- This chemical was referenced in eight sources
- Six sources mentioned product testing data and four included concentration data:
  - Sample of hard plastic, soft plastic, wood, and foam toys: median 0.0000001 percent
  - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000000187 to 0.0000000187 percent
  - Smart phones: not detected
- Two sources cited use in consumer products (electrical and electronic devices, flooring, fabric, furniture foam; window treatments) and one cited use in children's products (toys)
- Two sources reported human or environmental exposure data
- OECD use codes for this chemical included AC4a, AC5e, AC14f
- No source provided data on production volume.
- According to these sources, this chemical has been used in: electronics, building materials, paper and textile adhesives, polyurethane and polystyrene foam, and plastics
- One source mentioned this chemical in the context of end of life issues, and one mentioned laws or regulations

K.14.13 446255-39-6 BDE-196

- This chemical was referenced in six sources
- Three sources mentioned product testing data and two included concentration data:
  - New and secondhand children's toys: mean 0.0011 percent
  - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000000152 to 0.0000000361 percent
- Two sources cited use in consumer products (electronic appliances, furniture, upholstery; window treatments)
- Four sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified

- No source provided data on production volume.
- No source identified specific uses for this chemical
- Two sources mentioned this chemical in the context of end of life issues, and three mentioned laws or regulations

K.14.14 117964-21-3 BDE-197

- This chemical was referenced in six sources
- Four sources mentioned product testing data and four included concentration data:
    - New and secondhand children's toys: mean 0.0023 percent
    - TV: 0.006 - 0.0215; small appliances: 0.0018 to 0.075 percent; large appliances: not detected; other electronic: 0.01 to 0.112 percent; plastic toy: not detected; other plastic: 0.014 percent;
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000000375 to 0.0005298064 percent
- Two sources cited use in consumer products (electronic appliances, furniture, upholstery; window treatments)
- Four sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- According to these sources, this chemical has been used in: plastics and plastic components
- Two sources mentioned this chemical in the context of end of life issues, and three mentioned laws or regulations

K.14.15 437701-79-6 BDE-207

- This chemical was referenced in five sources
- Three sources mentioned product testing data and two included concentration data:
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000011714 to 0.0030706422 percent
    - Smart phones: not detected
- Two sources cited use in consumer products (electronic appliances, furniture, upholstery; window treatments)
- Three sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source identified specific uses for this chemical
- Two sources mentioned this chemical in the context of end of life issues

K.14.16 58965-66-5 PERBROMO-1,4-DIPHENOXYBENZENE

- This chemical was referenced in 5 sources
- One source mentioned product testing data but did not include concentration data
- One source cited use in consumer products (curtains)
- No sources reported human or environmental exposure data

- OECD use codes for this chemical included AC5e
- No source provided data on production volume.
- According to these sources, "no uses" have been identified.
- One source mentioned this chemical in the context of use trends.

K.14.17 68928-80-3 DIPHENYL ETHER, HEPTABROMO DERIVATIVE

- This chemical was referenced in five sources
- One source mentioned product testing data but did not include concentration data
- One source cited use in consumer products (plastic clothing hanger) and one cited use in children's products (toys)
- No sources reported human or environmental exposure data
- OECD use codes for this chemical included AC13f
- No source provided data on production volume.
- No source identified specific uses for this chemical
- Two sources mentioned this chemical in the context of laws or regulations

K.14.18 182677-30-1 2,2',3,4,4',5'-HEXABROMODIPHENYL ETHER

- This chemical was referenced in four sources
- Three sources mentioned product testing data and two included concentration data:
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000000033 to 0.0000000151 percent
    - Smart phones: not detected
- One source cited use in consumer products (window treatments)
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- According to these sources, this chemical has been used in: plastics and plastic components
- One source mentioned this chemical in the context of end of life issues

K.14.19 63387-28-0 1,2,3,4,5-PENTABROMO-6-(2,3,4,5-TETRABROMOPHENOXY)BENZENE

- This chemical was referenced in four sources
- Three sources mentioned product testing data and two included concentration data:
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000009156 to 0.001753243 percent
    - Smart phones: not detected
- Two sources cited use in consumer products (electronic appliances, furniture, upholstery; window treatments)
- Two sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified

- No source provided data on production volume.
- No source identified specific uses for this chemical
- Two sources mentioned this chemical in the context of end of life issues

K.14.20 189084-62-6 2,3',4',6-TETRABROMODIPHENYL ETHER

- This chemical was referenced in four sources
- Two sources mentioned product testing data and one included concentration data:
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): all non-detect
    - Smart phones: not detected
- Two sources cited use in consumer products (upholstered furniture, electrical and electronic equipment; casings of electronic equipment)
- One source reported human or environmental exposure data
- OECD use codes for this chemical include: AC2a
- No source provided data on production volume.
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of end of life issues, and one mentioned laws or regulations

K.14.21 101-55-3 P-BROMODIPHENYL ETHER

- This chemical was referenced in three sources
- Two sources mentioned product testing data and two included concentration data:
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): all non-detect
    - Smart phones: not detected
- One source cited use in consumer products (window treatments)
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of end of life issues

K.14.22 189084-66-0 2,3',4,4',6-PENTABROMODIPHENYL ETHER

- This chemical was referenced in three sources
- Three sources mentioned product testing data and two included concentration data:
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000000093 to 0.0000005259 percent
    - Smart phones: not detected
- One source cited use in consumer products (window treatments)
- One source reported human or environmental exposure data
- OECD use codes for this chemical included AC5e

- No source provided data on production volume.
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of end of life issues, and one mentioned laws or regulations

K.14.23 147217-75-2 2,2',4-TRIBROMODIPHENYL ETHER

- This chemical was referenced in three sources
- Two sources mentioned product testing data and two included concentration data:
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000000015 to 0.0000001171 percent
    - Smart phones: not detected
- Two sources cited use in consumer products (window treatments; upholstered furniture, electrical and electronic equipment, and selected plastic products)
- No sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC14e
- No source provided data on production volume.
- According to these sources, this chemical has been used in: electronics
- One source mentioned this chemical in the context of end of life issues, and one mentioned laws or regulations

K.14.24 36483-60-0 HEXABROMODIPHENYL ETHER

- This chemical was referenced in three sources
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- Three sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of laws or regulations

K.14.25 337513-72-1 BDE-203

- This chemical was referenced in three sources
- Three sources mentioned product testing data and one included concentration data:
    - Smart phones: not detected
- One source cited use in consumer products (appliances, furniture, upholstery)
- Two sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source identified specific uses for this chemical
- Three sources mentioned this chemical in the context of end of life issues, and one mentioned laws or regulations

K.14.26 63936-56-1 NONABROMODIPHENYL ETHER

- This chemical was referenced in three sources
- No source mentioned product testing
- No source cited use in consumer products
- One source reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- Uses for this chemical: thermoplastic resins, thermoset resins, textiles and adhesives
- No sources mentioned this chemical in the context of supply chain issues, substitutes, end of life issues, or laws or regulations

K.14.27 243982-82-3 2,2',4,5'-TETRABROMODIPHENYL ETHER

- This chemical was referenced in three sources
- Three sources mentioned product testing data and two included concentration data:
    - Children's car seats (combined concentration of foam, fabric, and composition): median: 0.00000044 percent
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): all non-detect
    - Smart phones: not detected
- Two sources cited use in consumer products (window treatments) and one cited use in children's products (car seats)
- No sources reported human or environmental exposure data
- OECD use codes for this chemical included AC5b
- No source provided data on production volume.
- No source provided data on uses
- One source mentioned this chemical in the context of end of life issues, and one mentioned laws or regulations

K.14.28 437701-78-5 2,2',3,3',4,5,5',6,6'-NONABROMODIPHENYL ETHER

- This chemical was referenced in two sources
- Two sources mentioned product testing data and one included concentration data:
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): all non-detect
- Two sources cited use in consumer products (appliances, furniture upholstery; window treatments)
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source provided data on uses
- One source mentioned this chemical in the context of laws or regulations

K.14.29 446255-50-1 BDE-201

- This chemical was referenced in two sources
- No sources mentioned product testing data
- No sources cited use in consumer products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source provided data on uses
- One source mentioned this chemical in the context of laws or regulations

K.14.30 189084-68-2 2,3,3',4,4',5,6-HEPTABROMODIPHENYL ETHER

- This chemical was referenced in two sources
- One source mentioned product testing data but did not provide concentration data for this chemical
- No source cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source identified specific uses for this chemical
- No source mentioned this chemical in the context of supply chain issues, substitutes, end of life, or laws or regulations

K.14.31 93703-48-1 BDE-77

- This chemical was referenced in two sources
- Two sources mentioned product testing data and two included concentration data:
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): all non-detect
    - Smart phones: not detected
- One source cited use in consumer products (window treatments)
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of end of life issues

K.14.32 2050-47-7 4,4'-DIBROMODIPHENYL ETHER

- This chemical was referenced in two sources
- Two sources mentioned product testing data and two included concentration data:
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000000081 to 0.0000000412 percent
    - Smart phones: not detected

- One source cited use in consumer products (window treatments)
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of end of life issues

K.14.33 51892-26-3 2,4DICHLORODIPHENYL ETHER

- This chemical was referenced in two sources
- Two sources mentioned product testing data and two included concentration data:
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): all non-detect
    - Smart phones: not detected
- One source cited use in consumer products (window treatments)
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of end of life issues

K.14.34 40088-47-9 TETRABROMODIPHENYL ETHER

- This chemical was referenced in two sources
- No sources mentioned product testing data
- No sources cited use in consumer products
- One source reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of laws or regulations

K.14.35 446254-32-6 BDE-61

- This chemical was referenced in two sources
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided data on production volume.
- No sources identified specific uses for this chemical
- One source mentioned this chemical in the context of laws or regulations

K.14.36 366791-32-4 1,2,3-TRIBROMO-5-(3,4-DIBROMOPHENOXY)BENZENE

- This chemical was referenced in one source
- One source mentioned product testing data and two included concentration data:
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): all non-detect
- One source cited use in consumer products (window treatments)
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of end of life issues

K.14.37 405237-85-6 1,2,3,4-TETRABROMO-5-(3,4-DIBROMOPHENOXY)BENZENE

- This chemical was referenced in one source
- One source mentioned product testing data and two included concentration data:
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): all non-detect
- One source cited use in consumer products (window treatments)
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of end of life issues

K.14.38 35854-94-5 2,2',4,4',6,6'-HEXABROMODIPHENYL ETHER

- This chemical was referenced in one source
- One source mentioned product testing data and included concentration data:
    - Smart phones: not detected
- One source cited use in consumer products (mobile phones)
- No sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a
- No source provided data on production volume.
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of end of life issues

K.14.39 446255-03-4 BDE-148

- This chemical was referenced in one source
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified

- No source provided data on production volume.
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of laws or regulations

K.14.40 446255-56-7 PBDE 205

- This chemical was referenced in one source
- One source mentioned product testing data and one included concentration data:
    - Smart phones: not detected
- No sources cited use in consumer products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of end of life issues

K.14.41 117948-63-7 BENZENE, 1,2,3,5-TETRABROMO-4-(2,4,6-TRIBROMOPHENOXY)-

- This chemical was referenced in one source
- One source mentioned product testing data and two included concentration data:
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000000075 to 0.0000054419 percent
- One source cited use in consumer products (window treatments)
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of end of life issues

K.14.42 446255-30-7 1,2,3,5-TETRABROMO-4-(3,4,5-TRIBROMOPHENOXY)BENZENE

- This chemical was referenced in one source
- One source mentioned product testing data and two included concentration data:
    - Three samples each of window curtain fabric, car interior foam, and car interior (other): 0.0000000068 to 0.0000000182 percent
- One source cited use in consumer products (window treatments)
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume.
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of end of life issues

K.14.43 67797-09-5 BDE-202

- This chemical was referenced in one source

- No sources mentioned product testing data
- No sources cited use in consumer products
- One source reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of end of life issues and one mentioned laws and regulations

K.14.44 446254-98-4 BDE-142

- This chemical was referenced in one source
- No sources mentioned product testing data
- One source cited use in children's products (toys)
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume
- No source identified specific uses for this chemical
- One source mentioned this chemical in the context of laws and regulations

K.14.45 189084-60-4 BDE-32

- This chemical was referenced in one source
- No sources mentioned product testing data
- No sources cited use in consumer products or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No source provided data on production volume
- No source identified specific uses for this chemical

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APPENDIX L | POLYHALOGENATED ORGANOPHOSPHATES

L.1 SUMMARY OF CHEMICALS – PHOPS

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
ALL	**Across all 42 of the PHOPs**		**11**	**34**	**12**	**NA**	**40**	**29**	**NA**	**NA**	**11**
1047637-37-5	2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(1-chloro-2-propanyl) bis(phosphate)	BCMP-BCMEP	0	1		high	0.9888	0			
1067-98-7	Tris(3-chloropropyl)phosphate		0	0		med	0.9065	4,255	74%	76%	
115-96-8	Tris(2-chloroethyl) phosphate	TCEP	3.5	1	27	high	0.9349	19,141	61%	55%	16
115-98-0	Bis(2-chloroethyl) vinylphosphonate		0	2	1	med	0.9608	1,261	43%	8%	
125997-20-8	Phosphoric acid, mixed 3-bromo-2,2-dimethylpropyl and 2-bromoethyl and 2-chloroethyl esters		0	2		high		7	0%		
126-72-7	Tris(2,3-dibromopropyl) phosphate	TDBPP	3	1	8	high	0.9868	10,811	64%	54%	9
13674-84-5	Tris(2-chloroisopropyl)phosphate	TCIPP, TCPP	3.5	1	24	high	0.9394	1,751	90%	87%	13
13674-87-8	Tris(1,3-dichloro-2-propyl) phosphate	TDCIPP, TDCPP	3.5	1	44	high	0.9784	5,202	84%	85%	16
1373346-90-7	dimethyl {[(4,6-dichloro-1,3,5-triazin-2-yl)oxy]methyl}phosphonate		0	0		low	0.9048	0			
140-08-9	Tris(2-chloroethyl) phosphite		1	1		med	0.8218	1,562	32%	45%	1
19186-97-1	Tris(tribromoneopentyl)phosphate	TTBNPP	1	1	5	high	0.9662	No CID			2
26248-87-3	Tris(chloropropyl)phosphate		0	1	2	med	0.9065	4,255	74%	76%	
26604-51-3	Tris(dichloropropyl) phosphate		0	1	1	med	0.9582	0			
27568-90-7	Ethanol, 2bromo, phosphate (3:1)		0	0		low	0.9306	129	40%	65%	
2788-11-6	Tris(2,4dibromophenyl) phosphate		0	0		low	0.9147	405	61%	78%	
29716-44-7	Tris(chloroethyl) phosphate		0	0		low	0.9349	19,141	61%	55%	
33125-86-9	Phosphoric acid, 1,2-ethanediyl tetrakis(2-chloroethyl) ester		0	2		med	0.9551	2,444	54%	50%	

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
34432-82-1	Bis(2,3-dibromopropyl) hydrogen phosphate--ammonia (1/1)		0	2		low	0.9874	0			
34621-99-3	Tetrakis(1-chloropropan-2-yl) ethane-1,2-diyl bis(phosphate)		0	1		low	0.9563	0			
35656-01-0	Tris(2bromo4methylphenyl) phosphate		0	0		low	0.8029	162	33%	54%	
36711-31-6	Bis(2,3-dibromopropyl) phosphate, magnesium salt		0	1		low	0.9874	0			
38051-10-4	Phosphoric acid, 2,2-bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester	BCMP-BCEP, V6	2	1	9	high	0.9879	360	63%	65%	6
40120-74-9	Tris(1,3-dichloropropyl)phosphate		0	1			0.96757754	3,094	72%	60%	
4351-70-6	Phosphonic acid, P-[1-[[(2-chloroethoxy)(2-chloroethyl)phosphinyl]oxy]ethyl]-, 1-[bis(2-chloroethoxy)phosphinyl]ethyl 2-chloroethyl ester		0	1		med	0.9462	165	15%	5%	
49690-63-3	Tris(dibromophenyl) phosphate		0	1		med	0.911	No CID			
5324-12-9	2,3-Dibromopropylphosphate		0	1		low	0.9874	192	91%	80%	
53461-82-8	Diethylene glycol bis[bis(2-chloroethyl)phosphate]		0	2		med	0.9044	0			
5412-25-9	Bis(2,3-dibromopropyl) hydrogen phosphate		0	2	1	high	0.9874	435	72%	68%	1
61090-89-9	2,4,8,10-Tetraoxa-3,9-diphosphaspiro[5.5]undecane, 3,9-bis[3-bromo-2,2-bis(bromomethyl)propoxy]-, 3,9-dioxide		0	1		med	0.9526	0			
6145-73-9	Tris(2-chloropropyl) phosphate		1	1	2	high	0.9096	7,335	70%	70%	1
6294-34-4	Bis(2-chloroethyl) 2-chloroethylphosphonate		1	1		med	0.9462	448	17%	8%	1
64864-08-0	Sodium bis(2,3-dibromopropyl) phosphate		0	1		low	0.9874	0			
66108-37-0	2,2-Bis(bromomethyl)-3-chloropropyl bis[2-chloro-1-(chloromethyl)ethyl] phosphate		0	1		med	0.9888	9	56%	83%	1
66519-18-4	potassium bis(2,3-dibromopropyl) phosphate		0	1		low	0.9874	0			

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
6749-73-1	Tris(1,3-dichloropropan-2-yl) phosphite		0	2		med	0.923	4	0%	0%	
7046-64-2	Tris(2,4,6-tribromophenyl) phosphate		0	1		med	0.9659	508	72%	73%	
72236-72-7	Bis(1,3-dichloropropan-2-yl) hydrogen phosphate		0	1	2	low	0.9757	1	100%		
76025-08-6	Bis(2-chloro-1-methylethyl) 2-chloropropyl phosphate		2	1		low	0.9814	10	100%		
76649-15-5	(2-Chloro-1-methylethyl) bis(2-chloropropyl) phosphate		1	1		low	0.9814	9	100%		
78-43-3	Tris(2,3-dichloropropyl)phosphate	TDCPP	0	2		high	0.9725	6,276	67%	75%	
84282-27-9	2Bromoethyl 5bromopentyl 2chloroethyl phosphate		0	0		low	0.9382	4	100%	100%	
98923-48-9	4-Bromo-2-chlorobutyl 3-bromo-2,2-dimethylpropyl phosphate		0	0		low	0.9897	0			

L.1.1 OVERVIEW

There are 42 substances in the OFR class "polyhalogenated organophosphates" (PHOPs), with key attributes described in the Summary by Chemical table (For field definitions and color scheme, see Guide to Summary Tables, Appendix B.1). Thirty-four of these substances are reported on major chemical inventories. Of these, 11 are active TSCA Inventory substances and another 12 are inactive.[28] An additional 11 substances (not on the TSCA Inventory) appear on other international inventories, including those of Japan, the EU, and China. The remaining substances do not appear on any inventories we reviewed.

During our literature search, we found that while some of the PHOP chemicals found on the TSCA active inventory are referenced in the literature, others are not. In our literature search, we were able to collect data for seven PHOP chemicals identified on the TSCA active inventory, two inactive TSCA inventory chemicals, and three chemicals identified in other (non-U.S.) inventories.

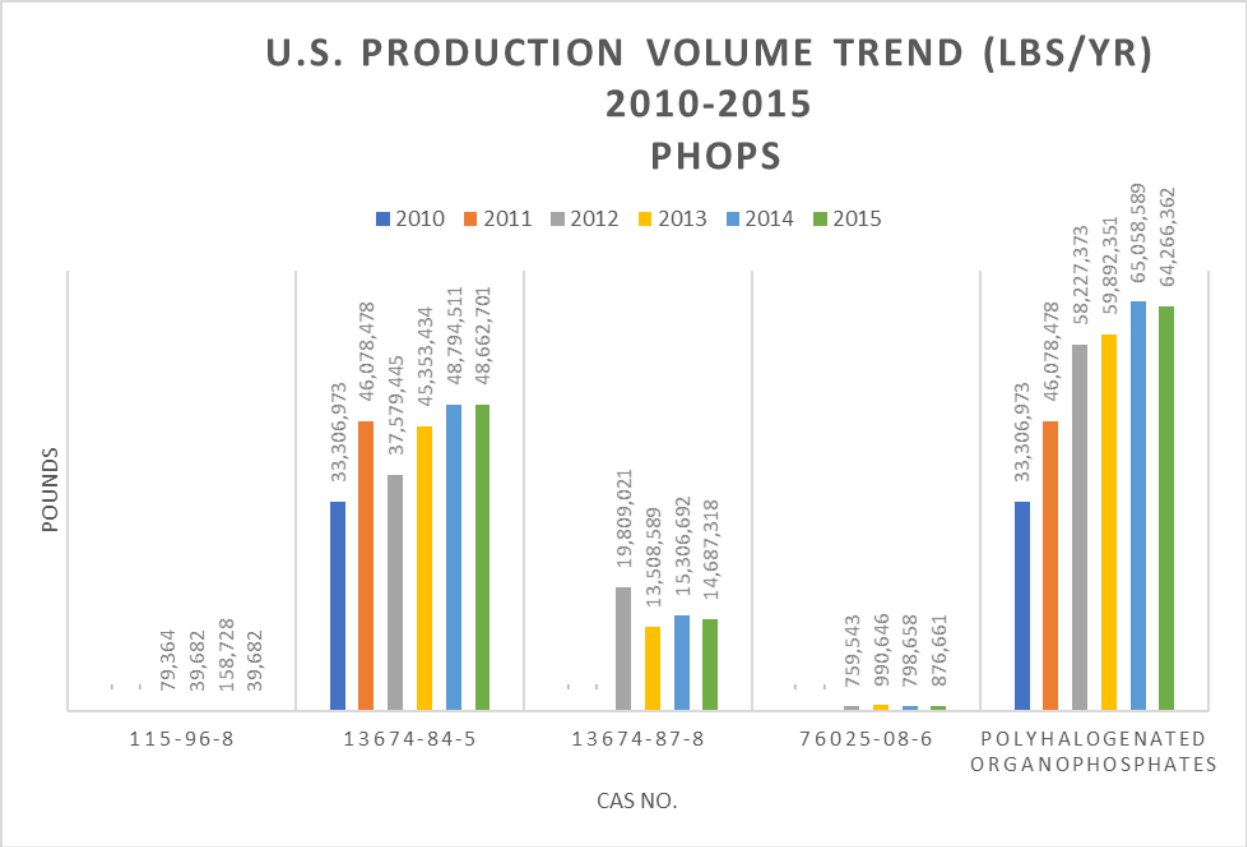
Databases with chemical use information were also searched (see Chapter 3). Patent data from PubChem reported information on 29 PHOP chemicals. The 12 PHOP chemicals with information from literature review also had information from database sources.

L.1.2 INDUSTRY PRODUCTION AND USE

Most of the available information from EPA focuses on six of the 42 PHOP chemicals, which are all active TSCA Inventory substances. Four of these substances account for most of the production activity in the United States.

For the most recent year available from EPA, 2015, U.S. industry reported manufacturing and importing PHOPs into the United States. Specifically, industry submitted three reports of manufacturing activity (one each for CAS Nos. 13674-84-5, 13674-87-8, and 6294-34-4), 18 reports of importing activity (CAS Nos. 13674-84-5 [13 reports], 13674-87-8 [2 reports], 76025-08-6 [2 reports] and 115-96-8 [1 report]), and seven additional reports where the activity was not specified or was claimed as CBI. Seventeen of the 28 reports received in 2015 were for TCPP (CAS No. 13674-84-5).

[28] The Toxic Substances Control Act (TSCA) Inventory is a list of chemical substances manufactured in or imported to the United States at some time since June 2006. For more information see https://www.epa.gov/tsca-inventory/tsca-inventory-notification-active-inactive-rule



Source: U.S. EPA CDR (2011-2016).

In the literature, PHOP chemicals are generally considered high production volume chemicals. PHOP chemicals appear to have been produced in large quantities for more than a decade. Total reported production volume (manufacturing plus importing) in 2015 included 48,662,701 pounds for CAS No. 13674-84-5; 14,687,318 pounds for CAS No. 13674-87-8; 876,661 pounds for CAS No. 76025-08-6; and 39,682 pounds for CAS No. 115-96-8. Production volume (PV) trend data for 2010-2015 indicates the combined PV for reported substances averaged 54.4 million pounds per year, over the period, with roughly 50 million pounds manufactured and 15 million pounds imported in 2015. The combined PV for chemicals in this class combined has increased from 33 million pounds in 2010 to 64 million pounds in 2015.

Chemical Data Reporting (CDR) data from EPA indicate that reportable PVs of PHOP chemicals have increased and that these chemicals have been produced in very large quantities, each year, for over a decade. An historical review of the CDR reveals chemicals in the PHOP subclass have been in production dating back to at least 1998.

Industry identified 28 processing and use activities for PHOP substances in 2015, of which 19 involved processing or use as a flame retardant. From industry reporting to EPA, uses as a flame retardant included:

- Construction;
- Plastic material and resin manufacturing;
- Plastic product manufacturing;
- Furniture and related product manufacturing;
- Textile, apparel, and leather manufacturing;
- All other chemical product and preparation manufacturing; and
- All other basic organic chemical manufacturing.

Six reports for CAS No. 13674-84-5 and two reports for CAS No. 13674-87-8 identified either a consumer or consumer/commercial use, but no reports identified a children's product use. This contrasts with product testing data found in the literature search and with reporting from the HPCDS, which indicate PHOPs are used in variety of consumer and children's products. Gaps in information within the supply chain, however, make it difficult for industry to know or reasonably ascertain if hazardous chemicals are or will be used in consumer or children's products. Industry indicated that for three PHOP chemicals, TCPP (CAS No. 13674-84-5), TDCPP (CAS No 13674-87-8, and CAS No. 76025-08-6, consumer product use was not known or reasonably ascertainable. A number of these reports were for uses in building materials or products, while two reports indicated use in foam seating and bedding products.

Over the period 2015-2019, industry has submitted a single report each year under the Toxics Release Inventory (TRI) for CAS No. 126-72-7. The use classifications for the chemical was included on two of the five reports, and was as follows:

- 3.3C: Z306. Otherwise use: ancillary or other use (Waste treatment).

TRI reports indicate the waste volume managed for this chemical fluctuated between 15,000 and 20,000 pounds per year for 2016-2019, but was only 14 pounds in 2015. All of these reports were from the "solid waste disposal" industry.

L.1.3 USE IN CONSUMER AND CHILDREN'S PRODUCTS

The states of Washington and Oregon require industry to report on chemicals of concern in products intended for use by children that are sold in those states. The reporting tool used by Washington and Oregon is known as the High Priority Chemicals Data System (HPCDS). According to data available from the HPCDS, manufacturers report the use of potentially hazardous PHOPs in children's products.

From 2012 to 2020, 282 reports were submitted to HPCDS identifying the use of PHOP chemicals in children's products. The most commonly-reported PHOP chemical was TCEP (CAS No. 115-96-8) accounting for 135 reports. Other reports for PHOPs were for CAS Nos. 13674-84-5 (35 reports), 13674-87-8 (35 reports), 38051-10-4 (6 reports) and 126-72-7 (1 report). Of the 282 total reports, 163 indicated the chemical function in each product was "flame retardant," and off these, 16 indicated the concentration in the final product exceeded 0.1 percent. Children's products falling into this group included: arts and crafts supplies (9 reports) and camping tents and outdoor play structures (5 reports), role play - housekeeping/gardening/DIY toys (1 report), and other toys (1 report). In these products, the components

containing the chemicals included synthetic polymers (synthetic rubber, plastics, foams etc.) and textiles (synthetic fibers and blends). In terms of specific chemicals:

- One report identified use of TCEP (CAS No. 115-96-8) as a flame retardant at a concentration greater than 0.1 percent in outdoor play structures (textiles).
- Twelve reports identified use of Tris (1-chloro-2-propyl) (CAS No. 13674-84-5), also referred to as TCPP, as a flame retardant at a concentration greater than 0.1 percent in arts and crafts supplies (synthetic polymers), children's camping tents (textiles), and other toys and games (synthetic polymers).
- Three reports identified use of TDCPP (CAS No. 13674-87-8) as a flame retardant at a concentration greater than 0.1 percent in arts and crafts supplies (synthetic polymers), outdoor play equipment (textiles), and housekeeping and gardening roleplay toys (textiles).

PHOPs have been cited in 52 of the 187 literature sources reviewed. Among the 12 PHOPs cited, chemicals appearing in the largest number of these include: CAS No. 13674-87-8 (44 sources), CAS No. 115-96-8 (27 sources) and CAS No. 13674-84-5 (24 sources). Several sources report the results of product testing, and these indicate PHOPs have been found in a variety of consumer and/or children's products, such as (reported concentrations in parentheses):

- Furniture foam (6.6 percent)
- Second hand toys (median 5 percent)
- Baby chairs and carriers (up to 4.4 percent)
- Curtains and wallpaper (<0.1 percent)
- Textiles/foam and baby products (<0.1 percent)

Uses for PHOPs identified through the literature review (as described in Chapter 3) include:

CAS No. 115-96-8: polyurethane foam for upholstered furniture and baby products, soft plastic and rubber toys, baby nap mats, portable cribs, nursing pillows, baby carriers, car seats, sleeping wedges, changing table pads, and nursing bath slings. It has been used in polyvinyl chloride (PVC) and roofing insulation, coatings and adhesives (including cellulose and polyester resins), and in textiles (including back coatings for carpets and in curtains). It has also been used in some electronics, such as TV casings.

CAS No. 126-72-7: baby textiles; soft non-PVC toys; baby mattresses; diaper-changing mats.

CAS No. 13674-84-5: durable infant or toddler products, toys, childcare articles, car seats, mattresses and mattress pads, electronic devices, resins and latexes, spray polyurethane foam insulation (spray foam), wallpaper. Also used in building insulation and refrigerator casings, isocyanurate PUF (usually rigid), PVC, EVA and phenolics, and epoxy resins.

CAS No. 13674-87-8: polyurethane foams (furniture and automotive), camping tents and other textiles (including curtains), children's car seats, strollers, sleeping mattresses and nursing pillows, gymnasium foam blocks, carpet padding, plastics, resins, textile coatings, rubber, wallpaper, electronics (LCD TV components, laptop components).

CAS No. 19186-97-1: polypropylene products such as carpets and stadium seats, and in curtains. The chemical is "recommended" for PP, HIPS, ABS, XPS, alloys in adhesives and fibers.

CAS No. 26248-87-3: televisions.

CAS No. 38051-10-4: flexible polyurethane foams for the automotive and furniture industry, baby products, mattresses and mattress pads.

CAS No. 6145-73-9: foam furniture and toys.

L.2 PHOPS ON NATIONAL AND INTERNATIONAL INVENTORIES AND REGISTRIES

Chemicals in class: 41

11 active on TSCA Inventory (recently manufactured/imported in U.S.)[29]

12 inactive on TSCA Inventory (no longer manufactured/imported in U.S.)

18 not on TSCA Inventory (never manufactured/imported in U.S.)

PHOPS ON THE TSCA ACTIVE INVENTORY	
115-96-8	Tris(2-chloroethyl) phosphate
126-72-7	Tris(2,3-dibromopropyl) phosphate
13674-84-5	Tris(2-chloroisopropyl)phosphate
13674-87-8	Tris(1,3-dichloro-2-propyl) phosphate
140-08-9	Tris(2-chloroethyl) phosphite
19186-97-1	Tris(tribromoneopentyl)phosphate
38051-10-4	Phosphoric acid, 2,2-bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester
6145-73-9	Tris(2-chloropropyl) phosphate
6294-34-4	Bis(2-chloroethyl) 2-chloroethylphosphonate
76025-08-6	Bis(2-chloro-1-methylethyl) 2-chloropropyl phosphate
76649-15-5	(2-Chloro-1-methylethyl) bis(2-chloropropyl) phosphate
PHOPS ON THE TSCA INACTIVE INVENTORY	
78-43-3	1-Propanol, 2,3-dichloro-, 1,1',1"-phosphate
115-98-0	Phosphonic acid, P-ethenyl-, bis(2-chloroethyl) ester
4351-70-6	Phosphonic acid, P-[1-[[(2-chloroethoxy)(2-chloroethyl)phosphinyl]oxy]ethyl]-, 1-[bis(2-chloroethoxy)phosphinyl]ethyl 2-chloroethyl ester
5412-25-9	1-Propanol, 2,3-dibromo-, 1,1'-(hydrogen phosphate)
6749-73-1	2-Propanol, 1,3-dichloro-, 2,2',2"-phosphite
33125-86-9	Phosphoric acid, P,P'-1,2-ethanediyl P,P,P',P'-tetrakis(2-chloroethyl) ester
34432-82-1	1-Propanol, 2,3-dibromo-, 1,1'-(hydrogen phosphate), ammonium salt (1:1)
34621-99-3	Phosphoric acid, P,P'-1,2-ethanediyl P,P,P',P'-tetrakis(2-chloro-1-methylethyl) ester
53461-82-8	Phosphoric acid, P,P'-(oxydi-2,1-ethanediyl) P,P,P',P'-tetrakis(2-chloroethyl) ester
61090-89-9	2,4,8,10-Tetraoxa-3,9-diphosphaspiro[5.5]undecane, 3,9-bis[3-bromo-2,2-bis(bromomethyl)propoxy]-, 3,9-dioxide
66108-37-0	Phosphoric acid, 2,2-bis(bromomethyl)-3-chloropropyl bis[2-chloro-1-(chloromethyl)ethyl] ester
125997-20-8	Phosphoric acid, mixed 3-bromo-2,2-dimethylpropyl and 2-bromoethyl and 2-chloroethyl esters

[29] "Active" indicates that U.S. manufacturing or importing activity has been reported since June 2006.

OTHER PHOPS ON INTERNATIONAL REGISTRIES		
1047637-37-5	2,2-Bis(chloromethyl)-1,3-propanediyl tetrakis(1-chloro-2-propanyl) bis(phosphate)	EU Reach
5324-12-9	2,3-Dibromopropylphosphate	Japan CSCL
26248-87-3	Tris(chloropropyl)phosphate	Japan CSCL
26604-51-3	Tris(dichloropropyl) phosphate	Japan CSCL
36711-31-6	Bis(2,3-dibromopropyl) phosphate, magnesium salt	Japan CSCL
49690-63-3	Tris(dibromophenyl) phosphate	Japan CSCL
64864-08-0	Sodium bis(2,3-dibromopropyl) phosphate	Japan CSCL
66519-18-4	potassium bis(2,3-dibromopropyl) phosphate	Japan CSCL
7046-64-2	Tris(2,4,6-tribromophenyl) phosphate	Japan CSCL, China IECSC
72236-72-7	Bis(1,3-dichloropropan-2-yl) hydrogen phosphate	Japan CSCL

L.3 U.S. MANUFACTURING AND IMPORTING ACTIVITY, 2015

NUMBER OF REPORTS BY ACTIVITY TYPE						
PHOPS	MANUFACTURE	IMPORT	BOTH MANUFACTURE AND IMPORT	NOT SPECIFIED	CBI	TOTAL
115-96-8		1				1
13674-84-5	1	13		2	1	17
13674-87-8	1	2		1	1	5
19186-97-1					1	1
38051-10-4					1	1
6294-34-4	1					1
76025-08-6		2				2
Total	**3**	**18**		**3**	**4**	**28**

Source: U.S. EPA, CDR (2016).

L.4 U.S. MANUFACTURING AND IMPORTING VOLUMES, 2015

REPORTED VOLUMES BY ACTIVITY TYPE					
PHOPS	MANUFACTURE	IMPORT	PRODUCTION VOLUME (MANUFACTURE + IMPORT)	USED	EXPORTED
115-96-8	-	39,682	39,682	-	-
13674-84-5	38,488,041	11,345,820	48,662,701	189,610	3,591,976
13674-87-8	11,600,141	3,087,177	14,687,318	3,345,575	22,080
19186-97-1	-	-	-	-	-
38051-10-4	-	-	-	-	-
6294-34-4	-	-	-	-	2,179
76025-08-6	-	876,661	876,661	-	-
Total	**50,088,182**	**15,349,340**	**64,266,362**	**3,535,185**	**3,616,235**

"-" = data CBI or otherwise not disclosed
Source: U.S. EPA, CDR (2016).

L.5 U.S. PRODUCTION VOLUME TRENDS, 2012-2015

PHOPS	PV 2015	PV 2014	PV 2013	PV 2012
115-96-8	39,682	158,728	39,682	79,364
13674-84-5	48,662,701	48,794,511	45,353,434	37,579,445
13674-87-8	14,687,318	15,306,692	13,508,589	19,809,021
19186-97-1	-	-	-	-
38051-10-4	-	-	-	-
6294-34-4	-	-	-	-
76025-08-6	876,661	798,658	990,646	759,543
Total	**64,266,362**	**65,058,589**	**59,892,351**	**58,227,373**

PV = manufacturing plus importing
"-" = data CBI or otherwise not disclosed
Source: U.S. EPA, CDR (2016).

L.6 TYPE OF PROCESSING OR USE REPORTS, 2015

	NUMBER OF REPORTS							
PHOPS	Processing as a Reactant	Processing—Incorporation Into Article	Processing—Incorporation Into Formulation, Mixture, or Reaction Product	Processing—Repackaging	Use—Non-Incorporative Activities	CBI	NKRA[A]	Grand Total
115-96-8							1	1
13674-84-5	2		14			1		17
13674-87-8	1		2					3
19186-97-1			1					1
38051-10-4			2					2
6294-34-4	1							1
76025-08-6			3					3
Total	**4**		**22**			**1**	**1**	**28**

[a]NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

L.7 INDUSTRIAL USE REPORTS, 2015

NUMBER OF REPORTS																								
PHOPS	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA[A]	Grand Total
115-96-8																							1	1
13674-84-5			1			8				1		1				3	1			2				17
13674-87-8				1						2														3
19186-97-1																	1							1
38051-10-4																						2		2
6294-34-4														1										1
76025-08-6						1										1	1							3
Totals			**1**	**1**		**9**				**3**		**1**		**1**		**4**	**3**			**2**		**2**	**1**	**28**
USED AS FLAME RETARDANT																								
115-96-8																								
13674-84-5			**1**			**5**				**1**						**3**	**1**			**1**				**12**
13674-87-8				**1**						**2**														**3**
19186-97-1																	**1**							**1**

NUMBER OF REPORTS																								
PHOPS	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA[A]	Grand Total
38051-10-4																								
6294-34-4																								
76025-08-6						**1**										**1**	**1**							**3**
Totals			**1**	**1**		**6**				**3**						**4**	**3**			**1**				**19**

[a]NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

L.8 INDUSTRIAL FUNCTION REPORTS, 2015

NUMBER OF REPORTS															
PHOPS	Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Other	Paint Additives and Coating Additives Not Described by Other Categories	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	CBI	NKRA[A]	Total
115-96-8														1	1
13674-84-5	2		1	12					2						17
13674-87-8				3											3
19186-97-1				1											1
38051-10-4													2		2
6294-34-4						1									1
76025-08-6				3											3
Totals	**2**		**1**	**19**		**1**			**2**				**2**	**1**	**28**

[a]NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

L.9 INDUSTRIAL SECTOR REPORTS, 2015

NUMBER OF REPORTS: POLYHALOGENATED ORGANOPHOSPHATES																							
PHOP	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
ALL INDUSTRIAL FUNCTIONS																							
Total			1	1		9				3		1		1		4	3			2		2	1	28
115-96-8																							1	1
13674-84-5			1			8				1		1				3	1			2				17
13674-87-8				1						2														3
19186-97-1																	1							1
38051-10-4																						2		2
6294-34-4														1										1
76025-08-6						1										1	1							3
USED AS FLAME RETARDANT																								
Total			1	1		6				3						4	3			1				19
13674-84-5			1			5				1						3	1			1				12

NUMBER OF REPORTS: POLYHALOGENATED ORGANOPHOSPHATES																							
PHOP	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
13674-87-8				1						2													3
19186-97-1																	1						1
76025-08-6						1										1	1						3

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

L.10 CONSUMER AND CHILDREN'S PRODUCT USE REPORTS, 2015

NUMBER OF REPORTS						
PHOPS	COMMERCIAL	CONSUMER	CONSUMER AND COMMERCIAL	NKRA[A]	CBI	TOTAL
13674-84-5	13	1	5			19
13674-87-8			2			2
19186-97-1	1					1
38051-10-4	4					4
76025-08-6	3					3
Totals	**21**	**1**	**7**			**29**

[a]NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

Reports for CAS No. 13674-84-5 in the "Consumer" and "Consumer and Commercial" use groups were for use in the following product categories:

- Adhesives and sealants (1 report)
- Building/construction materials not covered elsewhere (2 reports)
- Electrical and electronic products (1 report)
- Foam seating and bedding products (1 report)
- Insulating foam (1 report)

Reports for CAS No. 13674-87-8 in the "Consumer and Commercial" use group were for use in the following product categories:

- Foam seating and bedding products (1 report)
- CBI (1 report)

PHOPS	CHILDREN'S PRODUCT USE	NKRA[A]	OTHER USE	TOTAL
13674-84-5		5	14	19
13674-87-8		1	1	2
19186-97-1			1	1
38051-10-4			4	4
76025-08-6		2	1	3
Totals		**8**	**21**	**29**

[a]NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

L.11 TOXIC RELEASE INVENTORY REPORTS

TRI-REPORTABLE CHEMICALS	
126-72-7	Tris(2,3-dibromopropyl) phosphate

TOTAL PRODUCTION-RELATED WASTE REPORTED							
PHOPS		2015	2016	2017	2018	2019	TOTAL
126-72-7	No. of Reports	1	1	1	1	1	5
	Pounds of waste managed	14	20,477	18,410	16,669	15,748	71,318

Source: U.S. EPA, Toxics Release Inventory (2015-2019).
TRI Reports by Industry (2012-2015)

INDUSTRY	NO. OF REPORTS
Solid waste landfill	5

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

L.12 HIGH PRIORITY CHEMICALS DATA SYSTEM REPORTS

NUMBER OF REPORTS BY YEAR											
PHOPS		2012	2013	2014	2015	2016	2017	2018	2019	2020[1]	TOTAL
115-96-8	Total		1	18	4	31	65	5	7	4	135
	FR		1	2	1	1	61	3	4		73
	Conc>0.1%						1				1
126-72-7	Total								1		1
	FR								1		1
	Conc>0.1%										
13674-84-5	Total							11	19	5	35
	FR							8	9	1	18
	Conc>0.1%							5	6	1	12
13674-87-8	Total			3	2	24	64	4	5	3	105
	FR			2	1	1	58	2	3	1	68
	Conc>0.1%			1	1		1				3
38051-10-4	Total								6		6
	FR								3		3
	Conc>0.1%										
Total	**Total**		**1**	**21**	**6**	**55**	**129**	**20**	**38**	**12**	**282**
	FR		**1**	**4**	**2**	**2**	**119**	**13**	**20**	**2**	**163**
	Conc>0.1%			**1**	**1**		**2**	**5**	**6**	**1**	**16**

[1] Partial year reporting.

Source: Interstate Chemicals Clearinghouse (2021).

Reported uses include: arts/crafts variety packs, artists painting/drawing supplies, camping tents, outdoor play structures, role play - Housekeeping/Gardening/DIY Toys, and other toys.

L.13 PATENT COUNTS FROM PUBCHEM

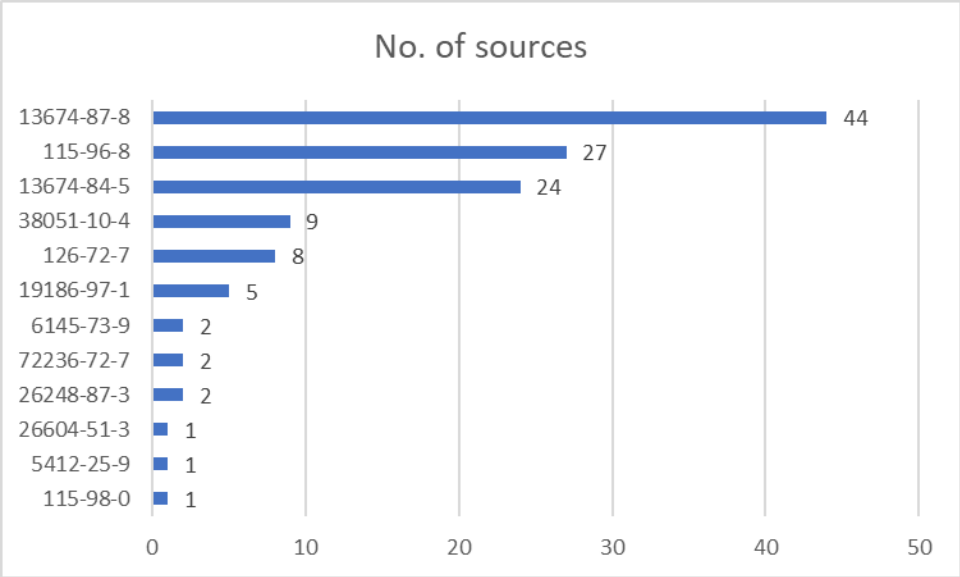
		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
78-43-3	6538	277	1,818	4,181	**6,276**	72	271	1,020	**1,363**	36	132	610	**778**
115-96-8	8295	1,344	6,043	11,754	**19,141**	291	1,161	1,748	**3,200**	127	641	711	**1,479**
115-98-0	8296	391	326	544	**1,261**	94	81	16	**191**	66	50	7	**123**
126-72-7	31356	854	3,024	6,933	**10,811**	333	620	1,130	**2,083**	177	362	600	**1,139**
140-08-9	8783	362	702	498	**1,562**	60	38	81	**179**	13	15	42	**70**
1067-98-7	14034	124	985	3,146	**4,255**	24	240	815	**1,079**	13	133	362	**508**
2788-11-6	14670658	1	156	248	**405**	1	15	57	**73**	1	12	13	**26**
4351-70-6	92985	91	50	24	**165**	46	11	3	**60**	16	7	2	**25**
5324-12-9	21393	8	9	175	**192**	7	1	32	**40**	6	1	13	**20**
5412-25-9	91543	60	62	313	**435**	36	14	107	**157**	13	11	50	**74**
6145-73-9	22522	89	2,085	5,161	**7,335**	39	370	968	**1,377**	13	169	348	**530**
6294-34-4	80518	67	306	75	**448**	11	72	7	**90**	7	40	5	**52**
6749-73-1	81228	4	0	0	**4**	1	0	0	**1**	1	0	0	**1**
7046-64-2	14778864	15	125	368	**508**	8	26	94	**128**	8	20	40	**68**
13674-84-5	26176	9	162	1,580	**1,751**	0	55	382	**437**	0	17	181	**198**
13674-87-8	26177	100	721	4,381	**5,202**	38	78	656	**772**	12	43	387	**442**
19186-97-1	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
26248-87-3	14034	124	985	3,146	**4,255**	24	240	815	**1,079**	13	133	362	**508**
26604-51-3	33553	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
27568-90-7	94383	47	31	51	**129**	15	7	41	**63**	13	6	35	**54**
29716-44-7	8295	1,344	6,043	11,754	**19,141**	291	1,161	1,748	**3,200**	127	641	711	**1,479**
33125-86-9	94445	35	1,079	1,330	**2,444**	16	217	234	**467**	7	110	66	**183**
34432-82-1	93173	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
35656-01-0	23106284	58	50	54	**162**	8	11	22	**41**	5	8	6	**19**
36711-31-6	5284348	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
38051-10-4	92310	63	72	225	**360**	33	15	90	**138**	10	6	56	**72**
49690-63-3	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
53461-82-8	104505	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**

		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
61090-89-9	109053	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
64864-08-0	23698011	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
66108-37-0	47815	4	0	5	**9**	1	0	5	**6**	1	0	5	**6**
66519-18-4	90474582	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
72236-72-7	188119	0	0	1	**1**	0	0	0	**0**	0	0	0	**0**
76025-08-6	22833419	0	0	10	**10**	0	0	0	**0**	0	0	0	**0**
76649-15-5	93459	0	0	9	**9**	0	0	0	**0**	0	0	0	**0**
84282-27-9	44146879	0	0	4	**4**	0	0	4	**4**	0	0	4	**4**
98923-48-9	71332080	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
125997-20-8	14150257	0	7	0	**7**	0	0	0	**0**	0	0	0	**0**
1047637-37-5	138395011	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
1373346-90-7	102197172	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
34621-99-3	92296	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
40120-74-9	38388	59	814	2,221	**3,094**	40	136	264	**440**	10	66	99	**175**

Source: PubChem Patent Data (See Exhibit 2-1 in main report and on OFR_universe_wPCPy_10122021.xlsx, tab 'Patent Info by CID' in Supplemental Information)

L.14 PHOPS CITED IN LITERATURE REVIEW

A literature search was conducted to identify sources with information about chemicals in this OFR class (see Chapter 3). PHOPs are mentioned or referenced in 52 of the 187 sources reviewed.



In this section, the following OECD use codes for chemicals are listed according to the internationally harmonized functional, product and article use categories:[30]

- AC2a. Complex articles. Machinery, mechanical appliances, electrical/electronic articles. Examples: Refrigerators, washing machines, vacuum cleaners, computers, telephones, drills, saws, smoke detectors, thermostats, radiators.
- AC4a. Stone, plaster, cement, glass and ceramic articles. Construction and building materials covering large surface areas. Examples: Cement flooring, Cement flooring, stone tile, mirrors, sinks, bathtubs.
- AC5a. Fabrics, textiles, and apparel. Construction and building materials covering large surface areas. Examples: Outdoor patio furniture Flooring or wall materials, carpets, rugs, tapestries.
- AC5b. Fabrics, textiles, and apparel. Toys intended for children's use (and child dedicated articles). Examples: stuffed toys, blankets, comfort objects.
- AC5e. Fabrics, textiles, and apparel. Furniture & furnishings, including furniture coverings. Examples: Sofa cover, car seat cover, fabric chair, hammock.
- AC5f. Fabrics, textiles, and apparel. Other articles with routine direct contact during normal use. Examples: Shirts, pants, shorts, blankets, sheets.

[30] Source: OECD (2017).

- AC5g. Fabrics, textiles, and apparel. Other articles made of fabrics, textiles and apparel that are not expected to routinely be in contact with people. Examples: Table umbrella mesh fabric.
- AC6e. Leather articles. Furniture & furnishings, including furniture coverings. Examples: Couches, sofas.
- AC8a. Paper articles. Construction and building materials covering large surface areas. Examples: Construction and building materials including insulation panels, wall papers.
- AC13f. Plastic articles (hard). Other articles with routine direct contact during normal use. Examples: Handles, pencils, handheld device casing.
- AC14a. Plastic articles (soft). Construction and building materials covering large surface areas. Examples: Blown or sprayed building insulation.
- AC14b. Plastic articles (soft). Toys intended for children's use (and child dedicated articles). Examples: Toys (dolls, car, animals).
- AC14e. Plastic articles (soft). Furniture & furnishings, including furniture coverings. Examples: Foam armchair, couch/sofa, mattress adult, mattress infant, mattress child, sleeping bag, beanbag chair.
- AC14f. Plastic articles (soft). Other articles with routine direct contact during normal use. Examples: Foam blocks used in foam block pits.

L.14.1 13674-87-8 TRIS(1,3-DICHLORO-2-PROPYL) PHOSPHATE

- This chemical was referenced in 44 sources
- Seventeen sources mentioned product testing data, while eight presented concentration data
    - Furniture foam: 6.6 percent
    - Second hand toys: median 5 percent
    - Curtains: 0.4 percent
    - Furniture foam: 1 to 5 percent
    - Tent samples: highest "application rate" of chemicals tested
    - Baby chairs and carriers: 0.1 to 4.4 percent
    - Children's car seats purchased in 2018: <0.1 percent
    - Smartphone components: <0.1 percent
- 23 sources cited use in consumer products (camping tents; textiles; window treatments; gymnasium foam; mobile phones and computers; upholstered furniture; wallpaper) and 14 cited use in children's products (nap mats; children's upholstered furniture; car seats; high chair headrests; toys; baby products)
- One source reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC5a, AC5b, AC5e, AC5f, AC5g, AC6e , AC13e, AC14b, AC14e, and AC14f
- One EPA (2015) source indicates U.S. production was in the range of 10 to 50 million pounds in 2011 (high production volume)
- According to these sources, this chemical has been used in polyurethane foams (furniture and automotive), camping tents and other textiles (including curtains), children's car seats, strollers,

sleeping mattresses and nursing pillows, gymnasium foam blocks, carpet padding, plastics, resins, textile coatings, rubber, wallpaper, electronics (LCD TV components, laptop components).
- Five sources mentioned this chemical in the context of use trends over time, three discussed alternatives to its use, two addressed end of life issues, and ten mentioned laws or regulations

L.14.2 115-96-8 TRIS(2-CHLOROETHYL) PHOSPHATE

- This chemical was referenced in 27 sources
- 11 sources mentioned product testing data, while 3 presented concentration data
    - Second hand toys: median of 4 percent
    - Baby chairs and carriers: up to 0.3 percent
    - Curtains and wallpaper: <0.1 percent
- 13 sources cited use in consumer products (upholstered furniture; electrical and electronic devices; textiles; window treatments; coatings and adhesives; carpet back coating; LCD television; gymnasium fam blocks) and eight cited use in children's products (nap mats; mattresses and furniture; portable cribs, nursing pillows, baby carriers, changing table pads; plastic toys)
- Six sources reported human or environmental exposure data
- OECD use codes for this chemical included AC4a, AC5a, AC5b, AC5e, AC5f, AC5g, AC14b, AC14e, AC14f
- One 2003 source indicated EU production was 2,040 tonnes (high production volume)
- According to these sources, this chemical has been used in: polyurethane foam for upholstered furniture and baby products, soft plastic and rubber toys, baby nap mats, portable cribs, nursing pillows, baby carriers, car seats, sleeping wedges, changing table pads, and nursing bath slings. It has been used in PVC and roofing insulation, coatings and adhesives (including cellulose and polyester resins), and in textiles (including back coatings for carpets and in curtains). It has also been used in some electronics, such as TV casings.
- Four sources mentioned this chemical in the context of use trends over time, two discussed alternatives to its use, two addressed end of life issues, and eight mentioned laws or regulations

L.14.3 13674-84-5 TRIS(2-CHLOROISOPROPYL)PHOSPHATE

- This chemical was referenced in 24 sources
- Six sources mentioned product testing data, while five presented concentration data
    - Baby chairs and carriers: up to 2.3 percent
    - E-waste, adaptors, heat sealer, powerboard, LCD TVs, TVs, plastic ornament: not detected
    - Curtain and carpet samples: not detected
- Twelve sources cited use in consumer products (window treatments; carpet; LCD TVs; electronics, clothing; upholstery; refrigerator casings; wallpaper) and five cited use in children's products (nap mats; seat cushions, mattresses, baby carriers; toys)
- Five sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC5a, AC5b, AC5e, AC8a, AC14a, AC14e

- One source (2020) identifies this chemical as the most important organophosphate FR in terms of volume (high production volume). An earlier source (2003) indicates the EU market at 22,940 tonnes.
- According to these sources, this chemical has been used in durable infant or toddler products, toys, childcare articles, car seats, mattresses and mattress pads, electronic devices, resins and latexes, spray polyurethane foam insulation (spray foam), wallpaper. Also used in building insulation and refrigerator casings, isocyanurate PUF, PVC, EVA and phenolics, and epoxy resins.
- Two sources mentioned this chemical in the context of use trends over time, one discussed alternatives, and six mentioned laws or regulations

L.14.4 38051-10-4 PHOSPHORIC ACID, 2,2-BIS(CHLOROMETHYL)-1,3-PROPANEDIYL TETRAKIS(2-CHLOROETHYL) ESTER

- This chemical was referenced in nine sources
- Five sources mentioned product testing data, while three presented concentration data
- Three sources cited use in consumer products (textiles; furniture foam) and four cited use in children's products (baby products foam; nursing pillows; durable infant/toddler products; toys; childcare articles; mattress and mattress pads)
- Two sources reported human or environmental exposure data
- OECD use codes for this chemical included AC5b, AC5f, AC14b, AC14e
- One source indicates production volume for 2000-2002 was <5000 tons in Europe and <454 tons in the United States. Another source placed the EU market size at 5000 tonnes in 2003.
- According to these sources, this chemical has been used in flexible polyurethane foams for the automotive and furniture industry, baby products, mattresses and mattress pads

Two sources mentioned this chemical in the context of use trends over time, one discussed alternatives to its use, and four mentioned laws or regulations

L.14.5 126-72-7 TRIS(2,3-DIBROMOPROPYL) PHOSPHATE

- This chemical was referenced in eight sources
- Two sources mentioned product testing data, and one source presented concentration data
    - <0.1 percent in 23 samples of textiles and foam from baby products
- One source cited use in consumer products (polyester fabrics and carpets) and one cited use in children's products (nap mats)
- Two sources reported human or environmental exposure data
- OECD use codes for this chemical included AC5b, AC14b, AC14e
- According to these sources, this chemical has been used in baby textiles; soft non-PVC toys; baby mattresses; diaper-changing mats
- One source mentioned use trends over time, one discussed alternatives to its use, and four mentioned laws or regulations

L.14.6 19186-97-1 TRIS(TRIBROMONEOPENTYL)PHOSPHATE

- This chemical was referenced in five sources
- One source mentioned product testing data (no concentration data)
- Three sources cited use in consumer products (window treatments; carpets and stadium seats; electronics, textiles)
- One source reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC5e, AC13f
- A 2017 source estimates EU consumption at 100 to 1000 tonnes/year (medium production volume)
- A 2020 source estimates the EU market at 10 to 100 tonnes (medium production volume)
- According to these sources, this chemical has been used in polypropylene products such as carpets and stadium seats, and in curtains. The chemical is "recommended" for PP, HIPS, ABS, XPS, alloys in adhesives and fibers.
- One source mentioned laws or regulations

L.14.7 6145-73-9 TRIS(2-CHLOROPROPYL) PHOSPHATE

- This chemical was referenced in two sources, but neither mentioned product testing or provided concentration data
- One 2003 source indicated EU production was >1,500 tonnes (high production volume)
- According to these sources, this chemical has been used in foam furniture and toys
- One source discussed alternatives to use of the chemical

L.14.8 72236-72-7 BIS(1,3-DICHLOROPROPAN-2-YL) HYDROGEN PHOSPHATE

- This chemical was referenced in two sources, but neither mentioned product testing or provided concentration data
- One source cited use in children's products
- Two sources reported human or environmental exposure data
- OECD use codes for this chemical included AC14e

L.14.9 26248-87-3 TRIS(CHLOROPROPYL)PHOSPHATE

- This chemical was referenced in two sources
- One source mentioned product testing data but it measured emission to air
- One source indicates the chemical has been used in televisions.
- One source mentioned production or use trends
- One source mentioned laws or regulations related to flame retardants

L.14.10 115-98-0 BIS(2-CHLOROETHYL) VINYLPHOSPHONATE

- This chemical was referenced in one source, but the source did not mention product testing or provide concentration data
- One source reported human or environmental exposure data
- No sources provided product use data for this chemical

L.14.11 26604-51-3 TRIS(DICHLOROPROPYL) PHOSPHATE

- This chemical was referenced in one source, but the source did not mention product testing or provide concentration data

L.14.12 5412-25-9 BIS(2,3-DIBROMOPROPYL) HYDROGEN PHOSPHATE

- This chemical was referenced in one source, but the source did not mention product testing or provide concentration data
- According to these sources, this chemical was formerly used as a fire-proofing agent for textiles and plastics but is no longer used as such

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APPENDIX M | POLYHALOGENATED PHENOL DERIVATIVES

M.1 CHEMICAL LIST – PHPDS

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
ALL	**Across all 8 PHPDs**		**4**	**5**	**6**	**NA**	**8**	**8**	**NA**	**NA**	**4**
118-79-6	2,4,6-Tribromophenol	2,4,6-TBP	1	1	12	high	0.7703	16,962	64%	65%	2
14400-94-3	2,3,4,6-Tetrabromophenol		0	0		low	0.8223	18	39%	100%	
36313-15-2	2,3,4,5-Tetrabromophenol		0	0		low	0.7075	2,408	66%	48%	
39635-79-5	4,4'-Sulphonylbis[2,6-dibromophenol]	Tetrabromobisphenol S	0	2	1	high	0.5219	5,233	62%	70%	
42757-55-1	1,1'-Sulfonylbis[3,5-dibromo-4-(2,3-dibromopropoxy)benzene]		2	1	2	high	0.9679	133	74%	72%	1
608-33-3	Phenol, 2,6-dibromo-		1	0	2	low	0.6203	2,541	58%	50%	
608-71-9	Pentabromophenol	PBR; Flammex 5BP	0	2	4	high	0.7561	2,718	46%	52%	3
615-58-7	2,4-Dibromophenol	2,4-DBP; FR-612	1	1	5	high	0.5301	2,177	41%	66%	1

M.1.1 OVERVIEW

There are eight substances in the OFR class "Polyhalogenated phenol derivatives" (PHPB), with key attributes described in the Summary by Chemical table (For field definitions and color scheme, see Guide to Summary Tables, Appendix B.1). Of these, four are active TSCA Inventory substances and another two are inactive. Three of the four active substances and one of the two inactive substances also appear on non-U.S. inventories. The two remaining substances do not appear on any other international inventories reviewed.

During our literature search, we found references to all of the TSCA active and inactive PHPD chemicals, and no references to either of the two substances not on the TSCA inventory.

Databases with chemical production and use information were also searched (see Chapter 3). Across all databases, two PHPD chemicals had some reported use information. Patent data from PubChem reported information on all eight PHPD chemicals. The six PHPD chemicals with information from literature review also had information from database sources.

M.1.2 INDUSTRY PRODUCTION AND USE

Most of the available information from EPA focuses on two of the eight PHPD chemicals, both of which are active TSCA Inventory substances. Production volume is reported for only one of these, CAS No. 42757-55-1.

For the most recent year available from EPA, 2015, U.S. industry submitted two reports of manufacturing activity (CAS No. 118-79-6) and one report of importing activity (CAS No. 42757-55-1). There were no additional reports where the activity was not specified or was claimed as CBI.

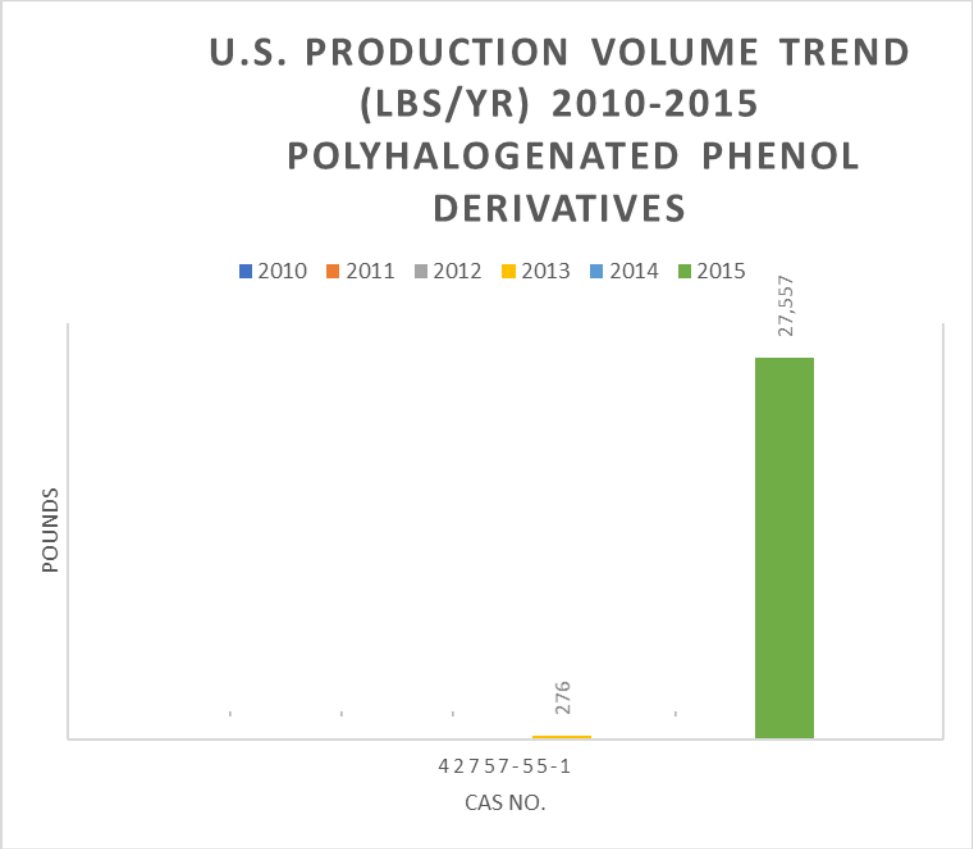
Total reported production volume (manufacturing plus importing) in 2015 included 27,000 pounds for CAS No. 42757-55-1. The only other production volume (PV) reported over the 2012-2015 timeframe was the import of 276 pounds in 2013.

Data from EPA indicate that PVs of PHPD chemicals may have been higher in the past. While there was no PV for any PHPD chemical reported in 2012, there were two reports in 2006, both in the 10 to 50 million pound range, (CAS No. 118-79-6) and a single report for the same chemical in the same PV range in 1998.

The literature contains limited information about PHPD chemical production volume or demand. One source from 2003 indicates the EU market for three PHPDs was over 1,500 tonnes per year (CAS Nos. 118-79-6, 608-71-9, and 615-58-7).

Industry identified three processing and use activities for PHPD substances in 2015, of which one involved processing or use as a flame retardant. From industry reporting to EPA, uses as a flame retardant included:

- Electrical equipment, appliance, and component manufacturing



Source: U.S. EPA, CDR (2011-2016).

In 2015, no reports for PHPD chemicals indicated either a consumer or consumer/commercial use, or any children's product use. This is substantiated in the literature review, which found no references to use of PHPD chemicals in consumer or children's products. Gaps in information within the supply chain, however, may make it difficult for industry to know or reasonably ascertain if hazardous chemicals are or will be used in consumer or children's products.

Over the period 2015-2019, no reports were submitted under the Toxics Release Inventory (TRI) for any PHPD chemicals.

- Use in Consumer and Children's Products

M.1.3 USE IN CONSUMER AND CHILDREN'S PRODUCTS

The states of Washington and Oregon require industry to report on chemicals of concern in products intended for use by children that are sold in those states. The reporting tool used by Washington and Oregon is known as the High Priority Chemicals Data System (HPCDS). According to data available from the HPCDS, manufacturers have not reported use of PHPDs in children's products over the period 2012-2020.

PHPDs have been cited in 12 of the 187 literature sources reviewed. Among the six PHPDs cited, chemicals appearing in the greatest number of these sources include: CAS No. 118-79-6 (12 sources), CAS No. 615-58-7 (5 sources) and CAS No. 608-71-9 (4 sources).

Several sources report the results of product testing, focused on plastics resins and finished products. Findings include:

- Televisions, printers, a computer monitor and scanners, electrical power boards, adaptors, toys, and other household appliances: 0.02 to 0.7 percent (CAS No. 118-79-6)
- Casings of electrical/electronic devices: 0.01 to 0.8 percent (CAS No. 118-79-6)
- Various resins including HDPE, PP, coated foil, foil, NSP, PET, PS, ABS, and PO: < 0.01 percent (CAS Nos. 615-58-7, 608-33-3, and 118-79-6)

CAS No. 118-79-6: Televisions, printers, a computer monitor and scanners, electrical power boards, adaptors, toys, and other household appliances

CAS No. 615-58-7: Plastic resins

CAS No. 608-33-3: Plastic resins

CAS No. 118-79-6: Plastic resins

M.2 PHPDS ON NATIONAL AND INTERNATIONAL INVENTORIES AND REGISTRIES

Chemicals in class: 8

- 4 active on TSCA Inventory (recently manufactured/imported in U.S.)[31]
- 2 inactive on TSCA Inventory (no longer manufactured/imported in U.S.)
- 2 not on TSCA Inventory (never manufactured/imported in U.S.)

PHPDS ON THE TSCA ACTIVE INVENTORY	
118-79-6	2,4,6-Tribromophenol
608-33-3	Phenol, 2,6-dibromo-
615-58-7	2,4-Dibromophenol
42757-55-1	1,1'-Sulfonylbis[3,5-dibromo-4-(2,3-dibromopropoxy)benzene]
PHPDS ON THE TSCA INACTIVE INVENTORY	
608-71-9	Pentabromophenol
39635-79-5	4,4'-Sulphonylbis[2,6-dibromophenol]

OTHER PHPDS ON INTERNATIONAL REGISTRIES		
None		

[31] "Active" indicates that U.S. manufacturing or importing activity has been reported since June 2006.

M.3 U.S. MANUFACTURING AND IMPORTING ACTIVITY, 2015

NUMBER OF REPORTS BY ACTIVITY TYPE						
PHPDS	MANUFACTURE	IMPORT	BOTH MANUFACTURE AND IMPORT	NOT SPECIFIED	CBI	TOTAL
118-79-6	2					2
42757-55-1		1				1
Totals	**2**	**1**				**3**

Source: U.S. EPA, CDR (2016).

M.4 U.S. MANUFACTURING AND IMPORTING VOLUMES, 2015

REPORTED VOLUMES BY ACTIVITY TYPE					
PHPDS	MANUFACTURE	IMPORT	PRODUCTION VOLUME (MANUFACTURE + IMPORT)	USED	EXPORTED
118-79-6	-	-	-	-	-
42757-55-1	-	27,557	27,557	-	-
Totals	**-**	**27,557**	**27,557**	**-**	**-**

-- data CBI or otherwise not disclosed
Source: U.S. EPA, CDR (2016).

M.5 U.S. PRODUCTION VOLUME TRENDS, 2012-2015

PHPDS	PV 2015	PV 2014	PV 2013	PV 2012
118-79-6	-	-	-	-
42757-55-1	27,557	-	276	-
Totals	**27,557**	**-**	**276**	**-**

-- data CBI or otherwise not disclosed
PV = manufacturing plus importing
Source: U.S. EPA, CDR (2016).

M.6 TYPE OF PROCESSING OR USE REPORTS, 2015

NUMBER OF REPORTS								
PHPDS	Processing as a Reactant	Processing—Incorporation Into Article	Processing—Incorporation Into Formulation, Mixture, or Reaction Product	Processing—Repackaging	Use—Non-Incorporative Activities	CBI	NKRA	Grand Total
118-79-6	2							2
42757-55-1		1						1
Totals	**2**	**1**						**3**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

M.7 INDUSTRIAL USE REPORTS, 2015

NUMBER OF REPORTS				
PHPDS	ALL OTHER BASIC INORGANIC CHEMICAL MANUFACTURING	ALL OTHER CHEMICAL PRODUCT AND PREPARATION MANUFACTURING	ELECTRICAL EQUIPMENT, APPLIANCE, AND COMPONENT MANUFACTURING	TOTAL
118-79-6	1	1		2
42757-55-1			1	1
Total	**1**	**1**	**1**	**3**
USE AS FLAME RETARDANT				
42757-55-1			1	1
Total			**1**	**1**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

M.8 INDUSTRIAL FUNCTION REPORTS, 2015

NUMBER OF REPORTS															
PHPDS	Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Other	Paint Additives and Coating Additives Not Described By Other Categories	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	CBI	NKRA	Grand Total
118-79-6						2									2
42757-55-1				1											1
Total				**1**		**2**									**3**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

M.9 INDUSTRIAL SECTOR REPORTS, 2015

NUMBER OF REPORTS: POLYHALOGENATED PHENOL DERIVATIVES																								
PHPD	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
ALL INDUSTRIAL FUNCTIONS																								
Total		1		1				1																3
118-79-6		1		1																				2
42757-55-1								1																1
USED AS FLAME RETARDANT																								
Total								1																1
118-79-6																								
42757-55-1								1																1

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

M.10 CONSUMER AND CHILDREN'S PRODUCT USE REPORTS, 2015

NUMBER OF REPORTS						
PHPDS	COMMERCIAL	CONSUMER	CONSUMER AND COMMERCIAL	NKRA	CBI	TOTAL
42757-55-1	1					1

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

PHPDS	CHILDREN'S PRODUCT USE	NKRA	OTHER USE	TOTAL
None				

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

M.11 TOXIC RELEASE INVENTORY REPORTS

TRI-REPORTABLE CHEMICALS	
None	

TOTAL PRODUCTION-RELATED WASTE REPORTED							
PHPDS		2015	2016	2017	2018	2019	GRAND TOTAL
None	No. of Reports						
	Pounds of waste managed						

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TRI Reports by Industry:

None.

M.12 HIGH PRIORITY CHEMICALS DATA SYSTEM REPORTS

NUMBER OF REPORTS BY YEAR											
PHPDS		2012	2013	2014	2015	2016	2017	2018	2019	2020[1]	TOTAL
None	Total										
	FR										
	Conc>0.1%										

[1] Partial year reporting.
Source: Interstate Chemicals Clearinghouse (2021).

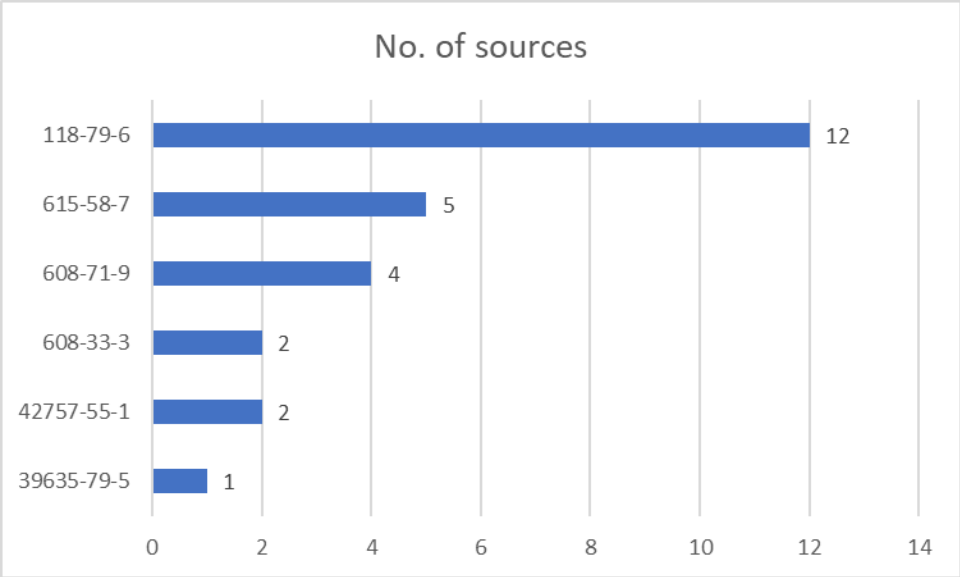
M.13 PATENT COUNTS FROM PUBCHEM

		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
118-79-6	1483	713	5,420	10,829	**16,962**	194	987	2,226	**3,407**	101	612	1,138	**1,851**
608-33-3	11847	143	919	1,479	**2,541**	16	49	65	**130**	13	17	32	**62**
608-71-9	11852	377	1,085	1,256	**2,718**	150	269	457	**876**	70	161	191	**422**
615-58-7	12005	180	1,104	893	**2,177**	8	23	59	**90**	6	14	33	**53**
14400-94-3	26665	9	2	7	**18**	0	0	1	**1**	0	0	1	**1**
36313-15-2	13643138	96	729	1,583	**2,408**	38	70	98	**206**	24	44	42	**110**
39635-79-5	170231	74	1,890	3,269	**5,233**	34	359	922	**1,315**	22	259	429	**710**
42757-55-1	3016379	0	35	98	**133**	0	19	50	**69**	0	13	31	**44**

Source: PubChem Patent Data (See Exhibit 2-1 in main report and on OFR_universe_wPCPy_10122021.xlsx, tab 'Patent Info by CID' in Supplemental Information)

M.14 PHPDS CITED IN LITERATURE REVIEW

A literature search was conducted to identify sources with information about chemicals in this OFR class (see Chapter 3). PHPDs are mentioned or referenced in 12 of the 187 sources reviewed.



In this section, the following OECD use codes for chemicals are listed according to the internationally harmonized functional, product and article use categories:[32]

- AC13e. Plastic articles (hard). Furniture & furnishings, including furniture coverings. Examples: Computer casing.
- AC13f. Plastic articles (hard). Other articles with routine direct contact during normal use. Examples: Handles, pencils, handheld device casing.
- AC14e. Plastic articles (soft). Furniture & furnishings, including furniture coverings. Examples: Foam armchair, couch/sofa, mattress adult, mattress infant, mattress child, sleeping bag, beanbag chair.

M.14.1 118-79-6 2,4,6-TRIBROMOPHENOL

- This chemical was referenced in 12 sources
- Three sources mentioned product testing data, including concentration data:
    - In one study, the chemical was found in the following resins:
        - PS = 20 to 680 ng/g (<0.0001 percent)
        - Coated foil = 10 ng/g (<0.0001 percent)
        - PET = 10 to 20ng/g (<0.0001 percent)

[32] Source: OECD (2017).

        - PP = 10 to 60 ng/g (<0.0001 percent)
        - NSP = 100 to 230ng/g (<0.0001 percent)
        - HDPE = 10 to 20 ng/g (<0.0001 percent)
        - ABS = 340,000ng/g (0.03 percent)
        - PO=440 ng/g (<0.0001 percent)
    - 26 consumer products were tested including televisions, printers, a computer monitor and scanners, electrical power boards, adaptors, televisions, toys, and other household appliances. Concentrations in the products ranged from 0.02 to 0.7 percent.
    - Four plastic samples from casings of electrical/electronic devices were tested. Concentrations in the products were 0.08, 0.02, 0.03, and 0.01 percent.

- No sources cited use in consumer products
- One source reported human or environmental exposure data
- OECD use codes for this chemical included AC13e
- Three sources classified this as a high production volume chemical.
- According to these sources, this chemical has been used in: electrical/electronic devices; electronic enclosures, paper, thermal insulation for building applications; and nylon.
- One source mentioned this chemical in the context of use trends over time, and one mentioned laws or regulations.

M.14.2 615-58-7 2,4-DIBROMOPHENOL

- This chemical was referenced in 5 sources
- In one study, the chemical was found in the following resins:
    - HDPE = 250 to 760 ng/g (<0.0001 percent)
    - PP = 25 to 240ng/g (<0.0001 percent)
    - Coated foil = 20 ng/g (<0.0001 percent)
    - Foil = 20 to 30 ng/g (<0.0001 percent)
    - NSP = 40 to 70 ng/g (<0.0001 percent)
    - PET = 50ng/g (<0.0001 percent)
    - PS = 20 to 40 ng/g (<0.0001 percent)
    - ABS = 8,000 ng/g (<0.01 percent)
    - PO = 120ng/g (<0.0001 percent)
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- OECD use codes for this chemical included AC13f
- One source estimates EU production at over 1,500 tonnes (high production volume)
- According to these sources, this chemical has been used in: HDPE
- One source mentioned this chemical in the context of use trends over time.

M.14.3 608-71-9 PENTABROMOPHENOL

- This chemical was referenced in 4 sources
- No sources provided product testing or concentration data
- No sources cited use in consumer or children's products

- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- One source estimates EU production at over 1,500 tonnes (high production volume)
- No uses were identified from these sources
- One source mentioned this chemical in the context of use trends over time.

M.14.4 608-33-3 PHENOL, 2,6-DIBROMO-

- This chemical was referenced in two sources
- In one study, the chemical was found in the following resins:
    - HDPE = 250 to 760 ng/g
    - PP = 25 to 240ng/g
    - Coated foil = 20 ng/g
    - Foil = 20 to 30 ng/g
    - NSP = 40 to 70 ng/g
    - PET = 50ng/g
    - PS = 20 to 40 ng/g
    - ABS = 8,000 ng/g
    - PO = 120ng/g
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- One source estimates EU production at over 1,500 tonnes (high production volume)
- No uses were identified from these sources
- One source mentioned this chemical in the context of laws or regulations.

M.14.5 42757-55-1 1,1'-SULFONYLBIS[3,5-DIBROMO-4-(2,3-DIBROMOPROPOXY)BENZENE]

- This chemical was referenced in two sources
- No sources mentioned product testing or concentration data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- OECD use codes for this chemical included AC14e
- No source provided production volume information
- According to these sources, this chemical has been used in PU foam
- No sources mentioned this chemical in the context of use trends over time, substitutes, end of life issues, or laws or regulations.

M.14.6 39635-79-5 4,4'-SULPHONYLBIS[2,6-DIBROMOPHENOL]

- This chemical was referenced in one source
- No sources mentioned product testing or concentration data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- OECD use codes for this chemical included AC14e

- No source provided production volume information
- According to these sources, this chemical has been used in: PU foam
- No sources mentioned this chemical in the context of use trends over time, substitutes, end of life issues. One source mentioned laws or regulations.

M.15 LITERATURE SOURCES USED

Ballesteros-Gómez, A., Ballesteros, J., Ortiz, X., Jonker, W., Helmus, R., Jobst, K. J., . . . Reiner, E. J. (2017). Identification of novel brominated compounds in flame retarded plastics containing TBBPA by combining isotope pattern and mass defect cluster analysis. *Environmental Science & Technology, 51*(3), 1518-1526.

Ballesteros-Gómez, A., de Boer, J., & Leonards, P. E. G. (2014). A novel brominated triazine-based flame retardant (TTBP-TAZ) in plastic consumer products and indoor dust. *Environmental Science & Technology, 48*(8), 4468-4474.

Bolinius, D. J., Sobek, A., Löf, M. F., & Undeman, E. (2018). Evaluating the consumption of chemical products and articles as proxies for diffuse emissions to the environment. *Environmental Science: Processes & Impacts, 20*(10), 1427-1440.

Ekpe, O. D., Choo, G., Barceló, D., & Oh, J.-E. (2020). Introduction of emerging halogenated flame retardants in the environment *Comprehensive Analytical Chemistry* (Vol. 88, pp. 1-39): Elsevier.

Gustavsson, J., Fischer, S., Ahrens, L., & Wiberg, K. (2017). Replacement substances for the brominated flame retardants PBDE, HBCDD, and TBBPA.

Kefeni, K. K., Okonkwo, J. O., Olukunle, O. I., & Botha, B. M. (2011). Brominated flame retardants: sources, distribution, exposure pathways, and toxicity. *Environmental Reviews, 19*, 238-253.

Miyake, Y., Tokumura, M., Nakayama, H., Wang, Q., Amagai, T., Ogo, S., . . . Ogawa, K. (2017). Simultaneous determination of brominated and phosphate flame retardants in flame-retarded polyester curtains by a novel extraction method. *Science of The Total Environment, 601*, 1333-1339.

Pivnenko, K., Granby, K., Eriksson, E., & Astrup, T. F. (2017). Recycling of plastic waste: Screening for brominated flame retardants (BFRs). *Waste Management, 69*, 101-109.

UK Environment Agency. (2003). *Prioritisation of Flame Retardants for Environmental Risk Assessment*.

Wypych, A., & Wypych, G. (2021). *Databook of Flame Retardants*. Toronto: ChemTech Publishing.

Wypych, G. (2021). *Handbook of Flame Retardants*. Toronto: ChemTech Publishing.

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APPENDIX N | POLYHALOGENATED PHENOL-ALIPHATIC ETHER

N.1 SUMMARY OF CHEMICALS – PHPAES

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
ALL	**Across all 11 PHPAEs**		**4**	**7**	**5**	**NA**	**11**	**9**	**NA**	**NA**	**3**
20217-01-0	2,4-Dibromophenyl glycidyl ether		1	1		med	0.7887	120	71%	50%	
2167063-57-0	1,2,3-Tribromo-4-[(prop-2-en-1-yl)oxy]benzene	(Allyloxy)tribromobenzene	0	0		med	0.9665	250	76%	79%	
31977-87-4	1,1'-{[(2Z)-2,3-dibromobut-2-ene-1,4-diyl]bis(oxy)}bis(2,4,6-tribromobenzene)		0	0		med	0.9601	0			
3278-89-5	1,3,5-Tribromo-2-(prop-2-en-1-yloxy)benzene	FR-913; TBP-AE	1	1	6	high	0.9614	153	71%	58%	3
35109-60-5	1,3,5-Tribromo-2-(2,3-dibromopropoxy)benzene	Bromkal 73-5PE	0	1	5	high	0.9922	36	69%	77%	1
3555-11-1	Allyl pentabromophenyl ether	BRN 3338650; Flammex 5AE	0	0		high	0.9709	978	53%	64%	
37853-59-1	1,2-Bis(2,4,6-tribromophenoxy)ethane	BTBPE; FireMaster 680; FireMaster FF 680	1	1	24	high	0.9516	500	54%	54%	2
607-99-8	2,4,6-Tribromoanisole	2,4,6-TBA	0	1		med	0.9383	246	91%	73%	
61262-53-1	Benzene, 1,1'-[1,2-ethanediylbis(oxy)]bis[2,3,4,5,6-pentabromo-	FireMaster 695; Pyro-Chek 77B	0	2	2	high	0.9701	329	47%	33%	
7347-19-5	Tribromophenoxyethyl acrylate		1	1		low	0.9351	1,245	78%	27%	
99717-56-3	2-bromoallyl 2,4,6-tribromophenyl ethe		0	0	2	med	0.9149	0			

N.1.1 OVERVIEW

There are 11 substances in the OFR class "Polyhalogenated phenol-aliphatic ethers" (PHPAEs), with key attributes described in the Summary by Chemical table (For field definitions and color scheme, see Guide to Summary Tables, Appendix B.1). Five of these substances are reported on one or more chemical inventories we reviewed. Of these, four are active TSCA Inventory[33] substances and another three are inactive. All four active and one inactive TSCA Inventory substances also appear on one or more non-U.S. inventories. None of the remaining substances appear on any other international inventories reviewed.

During our literature search, we found that two of the four active and two of the three inactive TSCA Inventory PHPAEs are referenced in the literature. Two additional active chemicals were not referenced in the literature we reviewed. We also collected data on one substance that does not appear on any of the inventories reviewed. Patent information from PubChem was available for nine of the PHPAE substances.

N.1.2 INDUSTRY PRODUCTION AND USE

Most of the available recent information from EPA focuses on a single PHPAE chemical, CAS No. 3278-89-5, an active TSCA Inventory substance. In prior reporting periods, however, manufacturing and importing activity has been reported for additional PHPAE chemicals (CAS Nos. 37853-59-1, 7347-19-5, and 20217-01-0).

For the most recent year available from EPA, 2015, U.S. industry reported manufacturing and importing PHPAEs into the United States. Specifically, industry submitted one report of importing activity for CAS No. 3278-89-5.

Total reported production volume (manufacturing plus importing) in 2015 for CAS No. 3278-89-5 was not disclosed.

In 2012, the prior CDR reporting period, no reports of activity were submitted for any PHPAE chemical. In 2006, reports were submitted for CAS Nos. 3278-89-5 (1 report), 37853-59-1 (2 reports) and 7347-19-5 (1 report). In 1998 EPA received one report each for CAS Nos. 20217-01-0, 3278-89-5 and 37853-59-1. Data from EPA are insufficient to indicate any trend in the PV of PHPAE chemicals, individually or as a class. Results from the literature search indicated the PV for CAS No. 37853-59-1 may have exceeded 5,000 tonnes (high production volume) previously. Otherwise, it provided no further indications of domestic or global production volumes for PHPAE chemicals.

Industry identified one processing and use activity for PHPAE substances in 2015, but the use was identified as something other than as a flame retardant.

The single report submitted did not indicate any consumer or consumer/commercial use nor any children's product use. This contrasts with product testing data found in the literature search and with reporting from the HPCDS, which indicate PHPAEs are used in variety of consumer and, potentially, some children's products. Gaps in information within the supply chain make it difficult for

[33] The Toxic Substances Control Act (TSCA) Inventory is a list of chemical substances manufactured in or imported to the United States at some time since June 2006. For more information see https://www.epa.gov/tsca-inventory/tsca-inventory-notification-active-inactive-rule.

industry to know or reasonably ascertain if hazardous chemicals are or will be used in consumer or children's products.

None of the chemicals in this class are reportable under the Toxics Release Inventory. Thus, there are no reports indicating the waste volume managed.

N.1.3 USE IN CONSUMER AND CHILDREN'S PRODUCTS

The states of Washington and Oregon require industry to report on chemicals of concern in products intended for use by children that are sold in those states. The reporting tool used by Washington and Oregon is known as the High Priority Chemicals Data System (HPCDS). According to data available from the HPCDS, over the period 2013-2020, no reports were submitted for chemicals in this class.

PHPAEs have been cited in 2 of the 187 literature sources reviewed. Among the six PHPAEs cited, chemicals appearing in the greatest number of these sources include: CAS No. 37853-59-1 (21 sources), CAS No. 3278-89-5 (6 sources) and CAS No. 35109-60-5 (5 sources). Several sources report the results of product testing, and these indicate PHPAEs have been found in a variety of consumer and/or children's products, such as:

- Hard plastic toys, foam toys, rubber/soft plastic toys, textile and stuffed toys: median < 0.00001 percent
- Household and office products: detected in about half the products sampled but concentrations close to the detection limit
- Kitchen utensils: up to 0.11 percent
- Construction materials, electrical and electronic devices, flooring, fabric, upholstery: detected in electrical and electronic devices but at a maximum of 0.0000317 percent
- XPS and extruded PS: 0.0044 to 0.0216 percent

Uses for PHPAEs identified through the literature review (as described in Chapter 3) include:

CAS No. 37853-59-1: Applications in HIPS, ABS, thermoplastics, thermoset resins, polycarbonate and coatings. Replacement for Octa-BDE in ABS, thermoplastics, polycarbonates and coatings.

N.2 PHPAES ON NATIONAL AND INTERNATIONAL INVENTORIES AND REGISTRIES

Chemicals in class: 11

- 4 active on TSCA Inventory (recently manufactured/imported in U.S.)[34]
- 3 inactive on TSCA Inventory (no longer manufactured/imported in U.S.)
- 4 not on TSCA Inventory (never manufactured/imported in U.S.)

PHPAES ON THE TSCA ACTIVE INVENTORY	
3278-89-5	1,3,5-Tribromo-2-(prop-2-en-1-yloxy)benzene
7347-19-5	Tribromophenoxyethyl acrylate
20217-01-0	2,4-Dibromophenyl glycidyl ether
37853-59-1	1,2-Bis(2,4,6-tribromophenoxy)ethane
PHPAES ON THE TSCA INACTIVE INVENTORY	
607-99-8	2,4,6-Tribromoanisole
35109-60-5	1,3,5-Tribromo-2-(2,3-dibromopropoxy)benzene
61262-53-1	Benzene, 1,1'-[1,2-ethanediylbis(oxy)]bis[2,3,4,5,6-pentabromo-

OTHER PHPAES ON INTERNATIONAL REGISTRIES		
None		

[34] "Active" indicates that U.S. manufacturing or importing activity has been reported since June 2006.

N.3 U.S. MANUFACTURING AND IMPORTING ACTIVITY, 2015

NUMBER OF REPORTS BY ACTIVITY TYPE						
PHPAES	MANUFACTURE	IMPORT	BOTH MANUFACTURE AND IMPORT	NOT SPECIFIED	CBI	TOTAL
3278-89-5		1				1

Source: U.S. EPA, CDR (2016).

N.4 U.S. MANUFACTURING AND IMPORTING VOLUMES, 2015

REPORTED VOLUMES BY ACTIVITY TYPE					
PHPAES	MANUFACTURE	IMPORT	PRODUCTION VOLUME (MANUFACTURE + IMPORT)	USED	EXPORTED
3278-89-5		--			--

-- data CBI or otherwise not disclosed
Source: U.S. EPA, CDR (2016).

N.5 U.S. PRODUCTION VOLUME TRENDS, 2012-2015

PHPAES	PV 2015	PV 2014	PV 2013	PV 2012
3278-89-5	--	--	--	--

-- data CBI or otherwise not disclosed
PV = manufacturing plus importing
Source: U.S. EPA, CDR (2016).

N.6 TYPE OF PROCESSING OR USE REPORTS, 2015

NUMBER OF REPORTS								
PHPAES	Processing as a Reactant	Processing—Incorporation Into Article	Processing—Incorporation Into Formulation, Mixture, or Reaction Product	Processing—Repackaging	Use—Non-Incorporative Activities	CBI	NKRA	Grand Total
3278-89-5	1							1

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

N.7 INDUSTRIAL USE REPORTS, 2015

NUMBER OF REPORTS																								
PHPAES	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
3278-89-5				1																				1
USED AS FLAME RETARDANT																								
3278-89-5																								0

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

N.8 INDUSTRIAL FUNCTION REPORTS, 2015

NUMBER OF REPORTS															
PHPAES	Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Other	Paint Additives and Coating Additives Not Described by Other Categories	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	CBI	NKRA	Grand Total
3278-89-5						1									1

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

N.9 INDUSTRIAL SECTOR REPORTS, 2015

NUMBER OF REPORTS: POLYHALOGENATED PHENOL-ALIPHATIC ETHER																								
PHPAE	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
ALL INDUSTRIAL FUNCTIONS																								
Total				1																				1
3278-89-5				1																				1
USED AS FLAME RETARDANT																								
None																								

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

N.10 CONSUMER AND CHILDREN'S PRODUCT USE REPORTS, 2015

NUMBER OF REPORTS						
PHPAES	COMMERCIAL	CONSUMER	CONSUMER AND COMMERCIAL	NKRA	CBI	TOTAL
None						

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

PHPAES	CHILDREN'S PRODUCT USE	NKRA	OTHER USE	TOTAL
None				

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

N.11 TOXIC RELEASE INVENTORY REPORTS

TRI-REPORTABLE CHEMICALS	
None	

TOTAL PRODUCTION-RELATED WASTE REPORTED							
PHPAES		2015	2016	2017	2018	2019	GRAND TOTAL
None	No. of Reports						
	Pounds of waste managed						

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TRI Reports by Industry:

None.

N.12 HIGH PRIORITY CHEMICALS DATA SYSTEM REPORTS

NUMBER OF REPORTS BY YEAR											
PHPAES		2012	2013	2014	2015	2016	2017	2018	2019	2020[1]	TOTAL
None	Total										
	FR										
	Conc>0.1%										

[1] Partial year reporting.
Source: Interstate Chemicals Clearinghouse (2021).

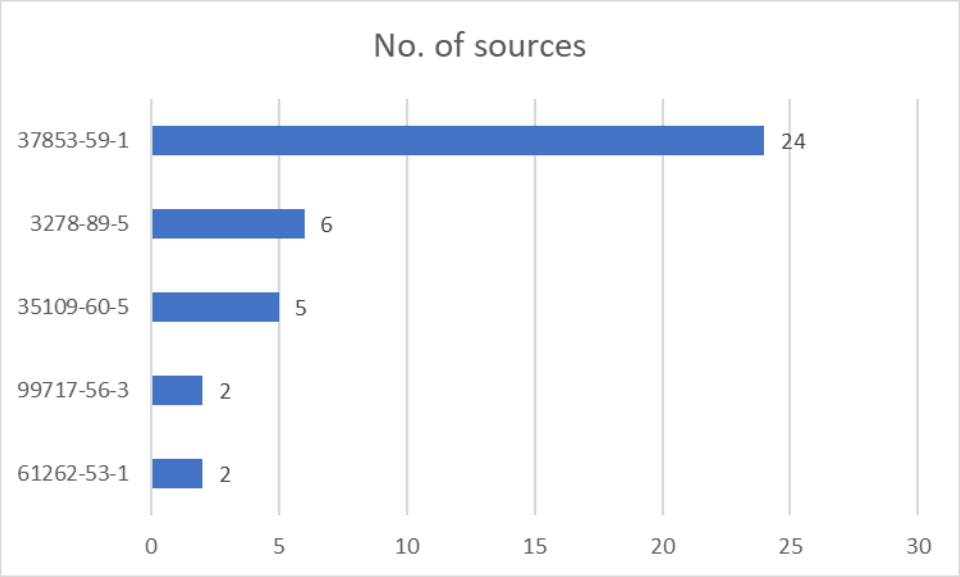
N.13 PATENT COUNTS FROM PUBCHEM

		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
607-99-8	11839	6	16	224	**246**	2	1	8	**11**	2	0	8	**10**
3278-89-5	76767	13	31	109	**153**	6	14	28	**48**	5	9	14	**28**
3555-11-1	19084	62	397	519	**978**	36	14	90	**140**	17	13	34	**64**
7347-19-5	81804	4	276	965	**1,245**	2	14	6	**22**	2	11	5	**18**
20217-01-0	62740	6	29	85	**120**	1	0	1	**2**	0	0	1	**1**
31977-87-4	154735126	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
35109-60-5	118216	8	3	25	**36**	3	2	17	**22**	2	2	12	**16**
37853-59-1	37840	43	189	268	**500**	26	94	142	**262**	19	59	96	**174**
61262-53-1	91678	23	153	153	**329**	8	88	47	**143**	6	57	31	**94**
99717-56-3	13643667	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
2167063-57-0	3015319	3	57	190	**250**	1	26	101	**128**	0	19	53	**72**

Source: PubChem Patent Data (See Exhibit 2-1 in main report and on OFR_universe_wPCPy_10122021.xlsx, tab 'Patent Info by CID' in Supplemental Information)

N.14 PHPAES CITED IN LITERATURE REVIEW

A literature search was conducted to identify sources with information about chemicals in this OFR class (see Chapter 3). PHPAEs are mentioned or referenced in 25 of the 187 sources reviewed.



In this section, the following OECD use codes for chemicals are listed according to the internationally harmonized functional, product and article use categories:[35]

- AC2a. Complex articles. Machinery, mechanical appliances, electrical/electronic articles. Examples: Refrigerators, washing machines, vacuum cleaners, computers, telephones, drills, saws, smoke detectors, thermostats, radiators.
- AC4a. Stone, plaster, cement, glass and ceramic articles. Construction and building materials covering large surface areas. Examples: Cement flooring, Cement flooring, stone tile, mirrors, sinks, bathtubs.
- AC5e. Fabrics, textiles, and apparel. Furniture & furnishings, including furniture coverings. Examples: Sofa cover, car seat cover, fabric chair, hammock.
- AC10d. Rubber articles. Articles intended for food contact. Examples: Plates, utensils.
- AC13b. Plastic articles (hard). Toys intended for children's use (and child dedicated articles). Examples: Toys (dolls, car, animals, teething rings).
- AC13d. Plastic articles (hard). Articles intended for food contact. Examples: Plastic dinner ware, food storage.

[35] Source: OECD (2017).

- AC13e. Plastic articles (hard). Furniture & furnishings, including furniture coverings. Examples: Computer casing.

N.14.1 37853-59-1 1,2-BIS(2,4,6-TRIBROMOPHENOXY)ETHANE

- This chemical was referenced in 24 sources
- 11 sources mentioned product testing data, including 8 with concentration data:
- Hard, foam and soft plastic/rubber toys: median = 101.1 ng/g (<0.00001 percent)
    - E-waste, vehicles, and textiles: maximum 0.0001 percent
    - Plastic kitchen utensils: <1.0 to 1,100,000 ng/g (0.11 percent)
    - XPS and extruded PS samples: 0.0044 to 0.0216 percent
    - Kitchen utensils: not detected
    - Construction materials, electrical and electronic devices, flooring, fabric, upholstery, and other daily use materials: maximum 0.0000317 percent
    - Various samples reported in other studies:
        - Biltong machine (dehydrator): 0.021555 percent
        - Book shelf: 0.004672 percent
        - Computer casing: 0.0496 percent
        - Cooling fan: 0.010779 percent
        - Cooling fan: 0.008309 percent
        - CRT monitor: 0.042518 percent
        - CRT monitor: 0.01511 percent
        - Decorative laminate: 0.068 percent
        - Flat screen monitor: 0.001306 percent
        - Flat screen monitor: 0.027865 percent
        - Foam chair: 0.021017 percent
        - Keyboard: 0.00507 percent
        - Keyboard: 0.1402 percent
        - Motherboard: 0.003193 percent
        - Motherboard: 0.10664 percent
        - Motherboard: 0.023745 percent
        - Plastic chair: 0.043072 percent
        - Plastic chair: 0.007894 percent
        - Printer: 0.004287 percent
        - PVC floor: 0.0293 percent
- Seven sources cited use in consumer products (electrical and electronic devices, flooring, fabric, upholstery; window treatments; kitchen utensils and items; LCD TVs) and two sources cited use in children's products (rubber/soft plastic toys, foam toys, stuffed toys, hard plastic toys)
- Seven sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC4a, AC5e, AC10d, AC13b, AC13d, AC13e
- Three sources cited production volume information. One source estimates annual production at 5,000 tonnes per year (high production volume).

- According to these sources, this chemical has been used in: ABS, HIPS, thermoplastics, thermoset resins, polycarbonate and coatings; expanded PS (EPS), extruded PS foam (XPS), and extruded PS; as a replacement for Octa-BDE and in ABS, thermoplastics, polycarbonates and coatings.
- Four sources mentioned this chemical in the context of substitutes, 4 mentioned laws or regulations, 3 addressed use trends over time, 2 addressed end of life issues, and 1 addressed supply chain issues

N.14.2 3278-89-5 1,3,5-TRIBROMO-2-(PROP-2-EN-1-YLOXY)BENZENE

- This chemical was referenced in 6 sources
- Three sources mentioned product testing, and two included concentration data:
    - Household and office products: detected in 50 percent of samples but close to LOD
    - Sound insulation: 0.0173 percent
    - Circuit boards: 0.183 percent
    - Dish cloths: 17 micrograms per cloth
- Two sources cited use in consumer products (LCD and other TVs; household/office products)
- No sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC13e
- No sources indicated production volume for this chemical.
- According to these sources, this chemical has been used in: electronics
- One source mentioned this chemical in the context of use trends over time

N.14.3 35109-60-5 1,3,5-TRIBROMO-2-(2,3-DIBROMOPROPOXY)BENZENE

- This chemical was referenced in 5 sources
- Three sources mentioned product testing data and two included concentration data:
    - E-waste, vehicles, construction materials, textiles: not detected
    - Car seats: 0.0000093 to 0.000028 percent
    - Dish cloth: 63 ng per cloth
- One source cited use in consumer products (LCD and other TVs)
- No sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a
- No source provided data on production volume.
- According to these sources, this chemical has been used in: electronics
- One source mentioned this chemical in the context of end of life issues, and one mentioned laws or regulations.

N.14.4 99717-56-3 2-BROMOALLYL 2,4,6-TRIBROMOPHENYL ETHER

- This chemical was referenced in two sources
- One source mentioned product testing data, including concentration data:
    - Dish cloth: 2 ng per cloth
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data

- No OECD use codes for this chemical were identified
- No sources indicated production volume for this chemical
- No specific uses for this chemical were identified
- No sources mentioned this chemical in the context of use trends over time, end of life issues, substitutes, supply chain issues, or laws or regulations.

N.14.5 61262-53-1 BENZENE, 1,1'-[1,2-ETHANEDIYLBIS(OXY)]BIS[2,3,4,5,6-PENTABROMO-

- This chemical was referenced in two sources
- No sources mentioned product testing data or included concentration data
- No sources cited use in consumer or children's products
- No sources reported human or environmental exposure data
- No OECD use codes for this chemical were identified
- No sources provided information on production volume
- No specific uses for this chemical were identified
- No sources mentioned this chemical in the context of use trends over time, supply chain issues, end of life issues, or laws or regulations.

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APPENDIX O | POLYHALOGENATED PHTHALATES/BENZOATES/IMIDES

O.1 SUMMARY OF CHEMICALS – PHPBIS

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
ALL	**Across all 19 PHPBIs**		**8**	**13**	**9**	**NA**	**17**	**18**	**NA**	**NA**	**7**
117-08-8	Tetrachlorophthalic anhydride	BRN 0211560; Niagathal; Tetrathal	2	1		high	0.9073	24,223	51%	37%	1
13810-83-8	Tetrabromophthalic acid	BRN 1885828	0	1	2	med	0.8729	6,173	56%	69%	
183658-27-7	2-Ethylhexyl 2,3,4,5-tetrabromobenzoate	Firemaster 550 component	2	1	21	high	0.9384	36	67%	74%	11
20566-35-2	2-(2-Hydroxyethoxy)ethyl 2-hydroxypropyl 3,4,5,6-tetrabromophthalate		2	1	4	high	0.4722	43	91%	100%	1
214216-08-7	bis(2,3-dibromopropyl) 3,4,5,6-tetrabromobenzene-1,2-dicarboxylate		0	0		low	0.9807	16	81%	79%	
25357-79-3	1,2-Benzenedicarboxylic acid, 3,4,5,6-tetrabromo-, sodium salt (1:2)		1	1		med	0.8729	14	64%	70%	
26040-51-7	Bis(2-ethylhexyl) tetrabromophthalate		3	1	20	high	0.9384	190	46%	44%	10
27581-13-1	2,3,4,5-Tetrabromobenzoic Acid		0	1	1	med	0.8729	112	80%	83%	1
32588-76-4	1,2-Bis(tetrabromophthalimido)ethane	BT 93; BT 93W; BT-93D; Citex BT 93; Saytex BT 93; Saytex BT 93W; Saytex BT93	1	1	8	high	0.6005	5,683	76%	76%	2
42597-49-9	1,2-Benzenedicarboxylic acid, 3,4,5,6-tetrabromo-, 1-butyl ester		0	1		low	0.8959	8	13%	33%	
55481-60-2	dimethyl 3,4,5,6-tetrabromobenzene-1,2-dicarboxylate		0	0		med	0.8235	42	76%	50%	
632-58-6	Tetrachlorophthalic acid	BRN 1914906	1	1	1	low	0.8729	16,995	55%	72%	

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
632-79-1	4,5,6,7-Tetrabromo-1,3-Isobenzofurandione	Bromophthal; Dion 6692 (VAN); FireMaster PHT 4; Firemaster Pht4; PHT 4; Saytex RB 49	2	1	6	high	0.9073	14,941	61%	59%	2
7415-86-3	1,2-Benzenedicarboxylic acid, 1,2-bis(2,3-dibromopropyl) ester		0	1	1	high	0.9293	58	86%	89%	
82001-21-6	Bis[(pentabromophenyl)methyl] 3,4,5,6-tetrabromobenzene-1,2-dicarboxylate		0	0		med	0.9134	25	100%	100%	
860302-33-6	Firemaster 550		0	0		low		No CID			
90075-91-5	Bis[(pentabromophenyl)methyl] benzene-1,4-dicarboxylate		0	0		med	0.9134	26	96%	95%	
92484-07-6	2-Butenediamide, N1,N4-bis(2,4,6-tribromophenyl)-, (2E)-		0	1		low	0.119353057	2	0%		
93202-89-2	N-2,3-Dibromopropyl-4,5-dibromohexahydrophthalimide		0	0		low	0.9242	61	100%	100%	

O.1.1 OVERVIEW

There are 19 substances in the OFR class "Polyhalogenated phthalates/benzoates/imides" (PHPBIs), with key attributes described in the Summary by Chemical table (For field definitions and color scheme, see Guide to Summary Tables, Appendix B.1). Ten of these substances are reported on one or more chemical inventories we reviewed. Of these, eight are active TSCA Inventory[36] substances and another three are inactive. All eight active TSCA Inventory substances appear on other (non-U.S.) inventories, and two additional substances not on the TSCA Inventory appear on non-U.S. inventories, including those of Japan and China. The remaining six substances do not appear on any inventories we reviewed.

During our literature search, we found that six of the eight PHPBI chemicals found on the TSCA active inventory are referenced in the literature. In our search, we were also able to collect data on one active chemical and two chemicals appearing on other inventories. Patent data from PubChem reported information on all 18 PHPBI chemicals with valid CIDs. The nine PHPBI chemicals with information from literature review also had information from database sources.

O.1.2 PRODUCTION AND USE INFORMATION

Most of the available information from EPA focuses on six of the 19 PHPBI chemicals, which are all active TSCA Inventory substances. Three substances account for most of the reported production (manufacturing or importing) activity in the United States.

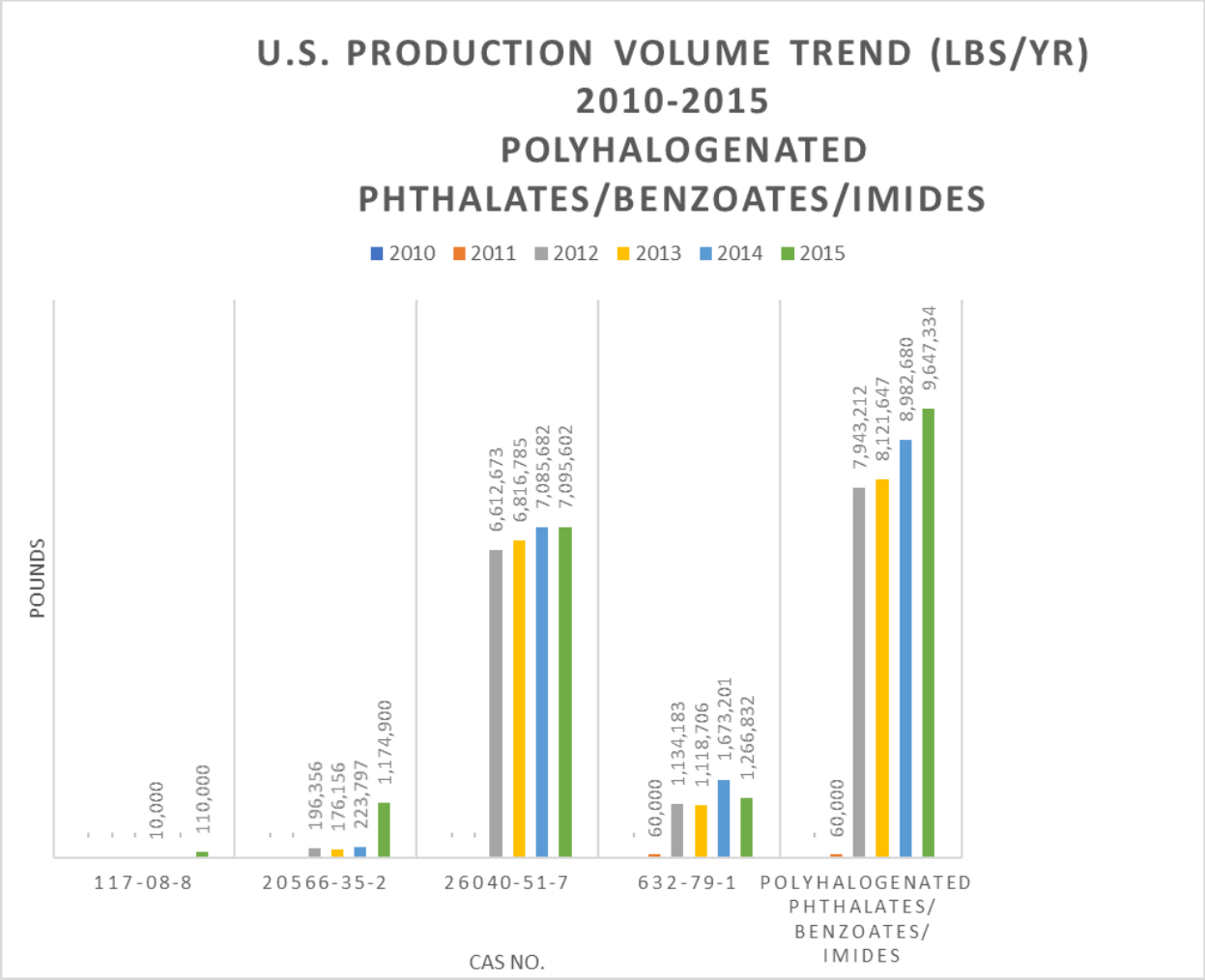
For the most recent year available from EPA, 2015, U.S. industry reported manufacturing and importing PHPBIs into the United States. Specifically, industry submitted nine reports of manufacturing activity (three each for CAS Nos. 20566-35-2 and 26040-51-7 and one each for CAS Nos. 183658-27-7, 32588-76-4, and 632-79-1), four reports of importing activity (CAS Nos. 632-79-1 [2 reports], 117-08-8 [1 report], and 20566-35-2 [1 report]), one report of both manufacturing and importing activity (CAS No. 632-79-1) and five additional reports where the activity was not specified or was claimed as CBI. Nine of the 19 reports received in 2015 were for (CAS No. 632-79-1).

The literature search indicates that a number of PHPBI chemicals are currently, or have been in the past, high production volume chemicals.

Total reported production volume (manufacturing plus importing) in 2015 included 7.0 million pounds for CAS No. 26040-51-7, 1.3 million pounds for CAS No. 632-79-1, and 1.2 million pounds for CAS No.

[36] The Toxic Substances Control Act (TSCA) Inventory is a list of chemical substances manufactured in or imported to the United States at some time since June 2006. For more information see https://www.epa.gov/tsca-inventory/tsca-inventory-notification-active-inactive-rule.

20566-35-2. Production volume (PV) trend data for 2010-2015 indicates the combined PV for reported substances averaged 5.8 million pounds per year.



Source: U.S. EPA, CDR (2011-2016)

Historical data from EPA indicate that PVs of PHPBI chemicals have decreased over time, as previously some of these chemicals individually were produced in the 1 to 10 and 10 to 50 million pound ranges.

Industry identified 25 processing and use activities for PHPBI substances in 2015, of which 16 involved processing or use as a flame retardant. From industry reporting to EPA uses as a flame retardant included:

- Plastics product manufacturing (5 reports)
- Furniture and related product manufacturing (4 reports)
- Plastic material and resin manufacturing (3 reports)

- All other basic organic chemical manufacturing (2 reports)
- Adhesive manufacturing (1 report)
- Custom compounding of purchased resin (1 report)

Five reports for CAS No. 26040-51-7 and one report for CAS No. 183658-27-7 identified a commercial/consumer use and one report for CAS No. 632-79-1 indicated child product use was not known or reasonably available. Gaps in information within the supply chain make it difficult for industry to know or reasonably ascertain if hazardous chemicals are or will be used in consumer or children's products.

Over the period 2015-2019, no PHPBI substances were reportable under the Toxics Release Inventory (TRI), thus there is no data available on uses or waste management quantities or practices for these substances.

O.1.3 USE IN CONSUMER AND CHILDREN'S PRODUCTS

In 2015, industry submitted five reports for CAS No. 26040-51-7 and one report for CAS No. 183658-27-7 identifying a consumer/commercial use. Two of the reports for CAS No. 26040-51-7 and one report for CAS No. 183658-27-7 further identified children's product use. The reports for 26040-51-7 were for uses in electrical and electronic products (1 report) and foam seating and bedding products (1 report). The report for 183658-27-7 was for also use in foam seating and bedding products.

The states of Washington and Oregon require industry to report on chemicals of concern in products intended for use by children that are sold in those states. The reporting tool used by Washington and Oregon is known as the High Priority Chemicals Data System (HPCDS). According to data available from the HPCDS, manufacturers have reported the use of potentially hazardous PHPBIs in children's products.

Over the period 2013-2020, 25 reports were submitted for two PHBI substances:15 reports for TBB (CAS No. 183658-27-7) and 10 reports for TBPH (CAS No. 26040-51-7). Three of these reports indicated the chemical function in each product was "flame retardant," but none reported the concentration in the final product exceeding 0.1 percent. Reporting by industry indicates that concerning PHPBIS chemicals may be present in children's products as contaminants, with no intended functional use.

PHPBI chemicals have been cited in 25 of the 187 literature sources reviewed. Among the nine PHPBI chemicals cited, chemicals appearing in the largest number of these include: CAS No. 183658-27-7 (21 sources), CAS No. 26040-51-7 (20 sources) and CAS No. 32588-76-4 (8 sources). Several sources report the results of product testing, and these indicate PHPBIs have been found in a variety of consumer and/or children's products, such as (reported concentrations in parentheses):

- Gymnastic pit foam (up to 1.37 percent)
- Baby products (1.85 percent)
- PU furniture foam (1.97 percent)
- Kitchen utensils (up to 0.003 percent)
- Motherboard (0.004807 percent)

- Flat screen monitor (0.001732 percent)
- CRT monitor (0.011064 percent)
- Mattress foam (< 0.00001 percent)

Uses for PHPBIs identified through the literature review (as described in Chapter 3) include::

CAS No. 183658-27-7: electrical adaptors, heat sealer, powerboards, LCD TVs, TVs, plastic ornament; furniture and baby foam products; polyurethane foams in upholstered furniture; furnishings, construction and automotive materials, textiles, coatings, adhesives; cable coatings, electrical wires, plastic roofing materials, and computer and television connectors; mattresses, electronics, household appliances, and foam used in gymnastic pits; polyvinyl chloride (PVC), neoprene, polyurethane foam (PUF), soft foams, wire and cable insulation, carpet backing, coated fabrics, and wall coverings; plastic and rubber products, textiles, leather, or fur.

CAS No. 26040-51-7: electrical adaptors, heat sealer, powerboards, LCD TVs, TVs, plastic ornaments; furniture and baby product foam; flexible PUF, textiles, flexible plastic/rubber, polyvinyl chloride (PVC), resin; furnishings, wire and cable, electrical and electronic products, construction and automotive materials, textiles, coatings, adhesives; couch foam and baby products (mattresses and high-chair foam), PUFs, flexible PVC plastic, adhesives, neoprene rubber, carpet backing, fabric coating, film and sheeting, wire and cable insulation, and wall coverings; plastic kitchen utensils; polyurethane foam for furniture and baby products; PVC, neoprene, wire insulation, carpet backing, coated fabrics, and wall coverings; cable and wires, conveyer belts (e.g., made of plasticized PVC), adhesives, coatings, films, coated fabrics, used in flexible PVC, thermoplastic olefinics (TPOs) and elastomers, thermoplastic resins, thermoset resins, textiles, adhesives, circuit boards, electronic enclosures, paper, thermal insulation for building applications: PE, PAN, PS, PP (homo- and copolymers), PVC, acrylonitrile butadiene styrene, PC-ABS, ABS, HIPS, epoxy resins, phenolic, unsaturated polyester resins, EPS, XPS, PS/PP.

CAS No. 32588-76-4: Electronics, wire and cable, construction materials; automobiles; “recommended” for HIPS, PE, PP, engineering plastics; engineering thermoplastics, HIPS, PP, PE in electronics, wire/cable, buildings, automotive; plastic and rubber products, textiles, leather, or fur; polyethylene polypropylene, thermoplastics, rubber, textiles, and other plastic materials; household curtains.

CAS No. 632-79-1: unsaturated polyesters, rigid polyurethane foams and paper; rigid PU polyols, wire coatings and wool; polymers and plastic products; and household curtains

CAS No. 20566-35-2: rigid PU foams for appliances; rigid PUF (unspecified); and plastic products, as an intermediate

O.2 PHPBIS ON NATIONAL AND INTERNATIONAL INVENTORIES AND REGISTRIES

Chemicals in class: 19

- 8 active on TSCA Inventory (recently manufactured/imported in U.S.)[37]
- 2 inactive on TSCA Inventory (no longer manufactured/imported in U.S.)
- 9 not on TSCA Inventory (never manufactured/imported in U.S.)

PHPBIS ON THE TSCA ACTIVE INVENTORY	
117-08-8	Tetrachlorophthalic anhydride
632-58-6	Tetrachlorophthalic acid
632-79-1	4,5,6,7-Tetrabromo-1,3-Isobenzofurandione
20566-35-2	2-(2-Hydroxyethoxy)ethyl 2-hydroxypropyl 3,4,5,6-tetrabromophthalate
25357-79-3	1,2-Benzenedicarboxylic acid, 3,4,5,6-tetrabromo-, sodium salt (1:2)
26040-51-7	Bis(2-ethylhexyl) tetrabromophthalate
32588-76-4	1,2-Bis(tetrabromophthalimido)ethane
183658-27-7	2-Ethylhexyl 2,3,4,5-tetrabromobenzoate
PHPBIS ON THE TSCA INACTIVE INVENTORY	
7415-86-3	1,2-Benzenedicarboxylic acid, 1,2-bis(2,3-dibromopropyl) ester
42597-49-9	1,2-Benzenedicarboxylic acid, 3,4,5,6-tetrabromo-, 1-butyl ester
92484-07-6	2-Butenediamide, N1,N4-bis(2,4,6-tribromophenyl)-, (2E)-

OTHER PHPBIS ON INTERNATIONAL REGISTRIES		
13810-83-8	Tetrabromophthalic acid	Japan CSCL
27581-13-1	2,3,4,5-Tetrabromobenzoic Acid	Japan CSCL

[37] "Active" indicates that U.S. manufacturing or importing activity has been reported since June 2006.

O.3 U.S. MANUFACTURING AND IMPORTING ACTIVITY, 2015

NUMBER OF REPORTS BY ACTIVITY TYPE						
PHPBIS	MANUFACTURE	IMPORT	BOTH MANUFACTURE AND IMPORT	NOT SPECIFIED	CBI	TOTAL
117-08-8		1				1
183658-27-7	1					1
20566-35-2	3	1				4
26040-51-7	3					3
32588-76-4	1					1
632-79-1	1	2	1	2	3	9
Totals	**9**	**4**	**1**	**2**	**3**	**19**

O.4 U.S. MANUFACTURING AND IMPORTING VOLUMES, 2015

REPORTED VOLUMES BY ACTIVITY TYPE					
PHPBIS	MANUFACTURE	IMPORT	PRODUCTION VOLUME (MANUFACTURE + IMPORT)	USED	EXPORTED
117-08-8	-	110,000	110,000	-	-
183658-27-7	-	-	-	-	-
20566-35-2	1,174,900	-	1,174,900	-	-
26040-51-7	7,095,602	-	7,095,602	-	1,050,247
32588-76-4	-	-	-	-	-
632-79-1	-	1,266,832	1,266,832	-	-
Totals	**8,270,502**	**1,376,832**	**9,647,334**	**-**	**1,050,247**

-- data CBI or otherwise not disclosed
Source: U.S. EPA, CDR (2016).

O.5 U.S. PRODUCTION VOLUME TRENDS, 2012-2015

PHPBIS	PV 2015	PV 2014	PV 2013	PV 2012
117-08-8	110,000	-	10,000	-
183658-27-7	-	-	-	-
20566-35-2	1,174,900	223,797	176,156	196,356
26040-51-7	7,095,602	7,085,682	6,816,785	6,612,673
32588-76-4	-	-	-	-
632-79-1	1,266,832	1,673,201	1,118,706	1,134,183
Totals	**9,647,334**	**8,982,680**	**8,121,647**	**7,943,212**

-- data CBI or otherwise not disclosed
PV = manufacturing plus importing
Source: U.S. EPA, CDR (2016).

O.6 TYPE OF PROCESSING OR USE REPORTS, 2015

	NUMBER OF REPORTS							
PHPBIS	Processing as a Reactant	Processing—Incorporation Into Article	Processing—Incorporation Into Formulation, Mixture, or Reaction Product	Processing—Repackaging	Use—Non-Incorporative Activities	CBI	NKRA	Total
117-08-8	1							1
183658-27-7		1	1					2
20566-35-2	1		3					4
26040-51-7		3	4	1				8
32588-76-4			3					3
632-79-1	4		3					7
Totals	**6**	**4**	**14**	**1**				**25**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

O.7 INDUSTRIAL USE REPORTS, 2015

NUMBER OF REPORTS																							
PHPBIS	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint And Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Total
117-08-8			1																				1
183658-27-7										2													2
20566-35-2				1		1											2						4
26040-51-7			1				1			2							4						8
32588-76-4	1															1	1						3
632-79-1			3	1									1			2							7
Totals	**1**		**5**	**2**		**1**	**1**			**4**			**1**			**3**	**7**						**25**
USED AS FLAME RETARDANT																							
183658-27-7										2													2
20566-35-2																	2						2
26040-51-7			1				1			2							2						6
32588-76-4	1															1	1						3
632-79-1			1													2							3
Totals	**1**		**2**				**1**			**4**						**3**	**5**						**16**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

O.8 INDUSTRIAL FUNCTION REPORTS, 2015

NUMBER OF REPORTS								
PHPBIS	Adhesives And Sealant Chemicals	Flame Retardants	Intermediates	Plasticizers	Processing Aids, Not Otherwise Listed	CBI	NKRA	Total
117-08-8				1				1
183658-27-7		2						2
20566-35-2		2	1		1			4
26040-51-7		6		2				8
32588-76-4		3						3
632-79-1	1	3	3					7
Total	**1**	**16**	**4**	**3**	**1**			**25**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

O.9 INDUSTRIAL SECTOR REPORTS, 2015

NUMBER OF REPORTS: POLYHALOGENATED PHTHALATES/BENZOATES/IMIDES																								
PHPBI	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
ALL INDUSTRIAL FUNCTIONS																								
Total	1		5	2		1	1			4			1			3	7							25
117-08-8			1																					1
183658-27-7										2														2
20566-35-2				1		1											2							4
26040-51-7			1				1			2							4							8
32588-76-4	1															1	1							3
632-79-1			3	1									1			2								7
USED AS FLAME RETARDANT																								
Total	1		2				1			4						3	5							16
183658-27-7										2														2
20566-35-2																	2							2
26040-51-7			1				1			2							2							6
32588-76-4	1															1	1							3
632-79-1			1													2								3

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

O.10 CONSUMER AND CHILDREN'S PRODUCT USE REPORTS, 2015

NUMBER OF REPORTS						
PHPBIS	COMMERCIAL	CONSUMER	CONSUMER AND COMMERCIAL	NKRA	CBI	TOTAL
183658-27-7			1			1
20566-35-2	3					3
26040-51-7	1		5			6
32588-76-4	3					3
632-79-1	4					4
Totals	**11**		**6**			**17**

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

Reports for CAS No. 26040-51-7 in the "Consumer and Commercial" use groups were for use in: *electrical and electronic products (2 reports), fabric, textile, and leather products not covered elsewhere (1 report), foam seating and bedding products (1 report), and plastic and rubber products not covered elsewhere (1 report).* The "Consumer and Commercial" report for 183658-27-7 was for use in *foam seating and bedding products.*

PHPBIS	CHILDREN'S PRODUCT USE	NKRA	OTHER USE	TOTAL
183658-27-7	1			1
20566-35-2			3	3
26040-51-7	2		4	6
32588-76-4			3	3
632-79-1		1	3	4
Totals	**3**	**1**	**13**	**17**

NKRA = not known or reasonably ascertainable

"Children's Product Use" reports for 26040-51-7 were for uses in *electrical and electronic products* (1 report) and *foam seating and bedding products* (1 report). The "Children's Product Use" report for 183658-27-7 was for use in *foam seating and bedding products*.

O.11 TOXIC RELEASE INVENTORY REPORTS

TRI-REPORTABLE CHEMICALS	
None	

TOTAL PRODUCTION-RELATED WASTE REPORTED							
PHPBIS		2015	2016	2017	2018	2019	TOTAL
None	No. of Reports						
	Pounds of waste managed						

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TRI Reports by Industry:

None.

O.12 HIGH PRIORITY CHEMICALS DATA SYSTEM REPORTS

NUMBER OF REPORTS BY YEAR											
PHPBIS		2012	2013	2014	2015	2016	2017	2018	2019	2020[1]	TOTAL
183658-27-7	Total							9	6		**15**
	FR								1		**1**
	Conc>0.1 percent										**0**
26040-51-7	Total							7	2	1	**10**
	FR								1	1	**2**
	Conc>0.1 percent										**0**

[1] Partial year reporting.

Source: Interstate Chemicals Clearinghouse (2021).

Products found in reports filed for CAS No. 183658-27-7 included clothing and bath/pool water toys. Products found in reports filed for CAS No. 26040-51-7 included clothing and dolls/building settings.

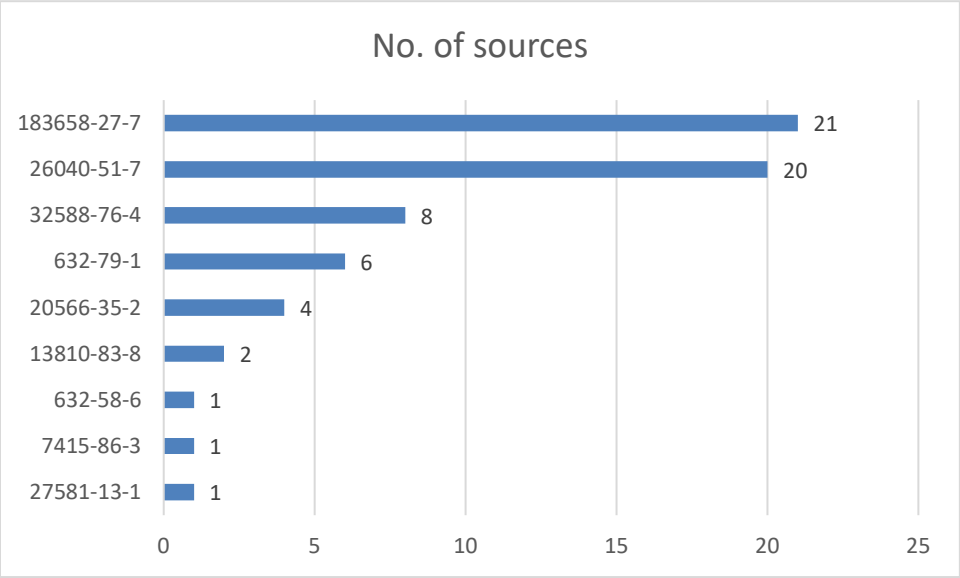
O.13 PATENT COUNTS FROM PUBCHEM

		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
117-08-8	8326	2,065	9,921	12,237	**24,223**	182	365	319	**866**	87	197	103	**387**
632-58-6	12442	1,418	6,273	9,304	**16,995**	100	101	515	**716**	51	55	456	**562**
632-79-1	12443	1,106	4,795	9,040	**14,941**	257	689	1,341	**2,287**	129	386	655	**1,170**
7415-86-3	110990	8	0	50	**58**	4	0	34	**38**	0	0	33	**33**
13810-83-8	83638	498	2,221	3,454	**6,173**	73	221	655	**949**	32	104	543	**679**
20566-35-2	89352	0	4	39	**43**	0	0	13	**13**	0	0	10	**10**
25357-79-3	117450	0	5	9	**14**	0	3	7	**10**	0	3	6	**9**
26040-51-7	117291	1	102	87	**190**	1	64	52	**117**	1	48	46	**95**
27581-13-1	15709948	1	21	90	**112**	0	8	40	**48**	0	8	30	**38**
32588-76-4	36183	38	1,319	4,326	**5,683**	17	495	1,630	**2,142**	11	319	1,052	**1,382**
42597-49-9	170675	7	0	1	**8**	2	0	1	**3**	1	0	1	**2**
55481-60-2	21389909	7	3	32	**42**	3	1	4	**8**	3	0	4	**7**
82001-21-6	20836198	0	0	25	**25**	0	0	21	**21**	0	0	20	**20**
90075-91-5	71430403	0	1	25	**26**	0	1	21	**22**	0	0	20	**20**
92484-07-6	6450496	0	2	0	**2**	0	0	0	**0**	0	0	0	**0**
93202-89-2	13184975	0	0	61	**61**	0	0	44	**44**	0	0	24	**24**
183658-27-7	71316600	0	12	24	**36**	0	6	17	**23**	0	6	13	**19**
214216-08-7	53856363	0	3	13	**16**	0	3	11	**14**	0	3	5	**8**
860302-33-6	nan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**

Source: PubChem Patent Data (See Exhibit 2-1 in main report and on OFR_universe_wPCPy_10122021.xlsx, tab 'Patent Info by CID' in Supplemental Information)

O.14 PHPBIS CITED IN LITERATURE REVIEW

A literature search was conducted to identify sources with information about chemicals in this OFR class (see Chapter 3). PHPBIs are mentioned or referenced in 26 of the 187 sources reviewed.



In this section, the following OECD use codes for chemicals are listed according to the internationally harmonized functional, product and article use categories:[38]

- AC2a. Complex articles. Machinery, mechanical appliances, electrical/electronic articles. Examples: Refrigerators, washing machines, vacuum cleaners, computers, telephones, drills, saws, smoke detectors, thermostats, radiators.
- AC5a. Fabrics, textiles, and apparel. Construction and building materials covering large surface areas. Examples: Outdoor patio furniture Flooring or wall materials, carpets, rugs, tapestries.
- AC5b. Fabrics, textiles, and apparel. Toys intended for children's use (and child dedicated articles). Examples: stuffed toys, blankets, comfort objects.
- AC5e. Fabrics, textiles, and apparel. Furniture & furnishings, including furniture coverings. Examples: Sofa cover, car seat cover, fabric chair, hammock.
- AC10d. Rubber articles. Articles intended for food contact. Examples: Plates, utensils.
- AC13a. Plastic articles (hard). Construction and building materials covering large surface areas. Examples: Outdoor play equipment, insulation (reacted off-site-, structural insulation panels), insulation applied on-site (spray polyurethane foam), flooring.
- AC14a. Plastic articles (soft). Construction and building materials covering large surface areas. Examples: Blown or sprayed building insulation.

[38] Source: OECD (2017).

- AC14e. Plastic articles (soft). Furniture & furnishings, including furniture coverings. Examples: Foam armchair, couch/sofa, mattress adult, mattress infant, mattress child, sleeping bag, beanbag chair.

O.14.1 183658-27-7 2-ETHYLHEXYL 2,3,4,5-TETRABROMOBENZOATE

- This chemical was referenced in 21 sources
- Eight sources mentioned product testing data, while 6 presented concentration data
    - Gymnastic foam pit: 1,400,000 to 13,700,000 ng/n (0.14 to 1.37 percent)
    - Baby products: mean of 18,510,000 ng/g (1.85 percent)
    - Furniture PU foam: mean of 19,760,000 ng/g (1.97 percent)
    - Mattresses: median of 3 ng/g (<.001 percent)
    - Sample of 96 kitchen utensils: <0.1 percent
    - Motherboard (0.004807 percent), flat screen monitor (0.001732 percent), CRT monitor (0.011064 percent)
- Eight sources cited use in consumer products (backpacking tents; LCD and other TVs; upholstered furniture; mattresses, electronics, household appliances, gymnasium foam; carpet backing) and three cited use in children's products (foam baby products; baby products)
- Four sources reported human or environmental exposure data
- OECD use codes for this chemical included AC2a, AC5b, AC5e, AC10d, AC14a, AC14e
- One source indicated EU production was 100-1,000 tonnes (medium production volume)
- According to these sources, this chemical has been used in: electrical adaptors, heat sealer, powerboards, LCD TVs, TVs, plastic ornament; furniture and baby foam products; polyurethane foams in upholstered furniture; furnishings, construction and automotive materials, textiles, coatings, adhesives; cable coatings, electrical wires, plastic roofing materials, and computer and television connectors; mattresses, electronics, household appliances, and foam used in gymnastic pits; polyvinyl chloride (PVC), neoprene, polyurethane foam (PUF), soft foams, wire and cable insulation, carpet backing, coated fabrics, and wall coverings; plastic and rubber products, textiles, leather, or fur.
- Four sources mentioned this chemical in the context of use trends over time, four discussed alternatives to its use, four addressed end of life issues, and six mentioned laws or regulations

O.14.2 26040-51-7 BIS(2-ETHYLHEXYL) TETRABROMOPHTHALATE

- This chemical was referenced in 20 sources
- Seven sources mentioned product testing data, while 4 presented concentration data
    - Electronic products: 71 to 70,000 ug/g (0.0071 to 7.0 percent)
    - Kitchen utensils: <0.2 to 30,000 ng/g (<.01 percent)
    - Gymnastic foam pit: 225,000 to 5,710,000 ng/g (0.02 to 0.57 percent)
    - Mattresses - median of 1 ng/g (<.00001 percent)
- Eight sources cited use in consumer products (LCD and other TVs, plastic ornaments; carpet backing, wall coverings; foam furniture; electrical and electronic products, textiles) and two cited use in children's products (foam baby products; baby products)
- Four sources reported human or environmental exposure data

- OECD use codes for this chemical included AC2a, AC5a, AC5b, AC5e, AC10d, and AC14e
- One source indicated EU production was 100-1,000 tonnes (medium production volume)
- According to these sources, this chemical has been used in: electrical adaptors, heat sealer, powerboards, LCD TVs, TVs, plastic ornaments; furniture and baby product foam; flexible PUF, textiles, flexible plastic/rubber, polyvinyl chloride (PVC), resin; furnishings, wire and cable, electrical and electronic products, construction and automotive materials, textiles, coatings, adhesives; couch foam and baby products (mattresses and high-chair foam), PUFs, flexible PVC plastic, adhesives, neoprene rubber, carpet backing, fabric coating, film and sheeting, wire and cable insulation, and wall coverings; plastic kitchen utensils; polyurethane foam for furniture and baby products; PVC, neoprene, wire insulation, carpet backing, coated fabrics, and wall coverings; cable and wires, conveyer belts (e.g., made of plasticized PVC), adhesives, coatings, films, coated fabrics, used in flexible PVC, thermoplastic olefinics (TPOs) and elastomers, thermoplastic resins, thermoset resins, textiles, adhesives, circuit boards, electronic enclosures, paper, thermal insulation for building applications: PE, PAN, PS, PP (homo- and copolymers), PVC, acrylonitrile butadiene styrene, PC-ABS, ABS, HIPS, epoxy resins, phenolic, unsaturated polyester resins, EPS, XPS, PS/PP.
- One source mentioned this chemical in the context of use trends over time, three discussed alternatives to its use, four addressed end of life issues, and nine mentioned laws or regulations.

O.14.3 32588-76-4 1,2-BIS(TETRABROMOPHTHALIMIDO)ETHANE

- This chemical was referenced in eight sources
- One source mentioned product testing data but contained no concentration data
- One source cited use in consumer products (window treatments)
- One source reported human or environmental exposure data
- OECD use codes for this chemical included AC5e
- One source indicated EU production was 5,200 tonnes (high production volume). Two other sources list it as a medium production volume chemical.
- According to these sources, this chemical has been used in: Electronics, wire and cable, construction materials; automobiles; “recommended” for HIPS, PE, PP, engineering plastics; engineering thermoplastics, HIPS, PP, PE in electronics, wire/cable, buildings, automotive; plastic and rubber products, textiles, leather, or fur; polyethylene polypropylene, thermoplastics, rubber, textiles, and other plastic materials; household curtains.
- One source mentioned this chemical in the context of use trends over time, one discussed alternatives to its use, and one mentioned laws or regulations.

O.14.4 632-79-1 4,5,6,7-TETRABROMO-1,3-ISOBENZOFURANDIONE

- This chemical was referenced in six sources
- One source mentioned product testing data but contained no concentration data
- One source cited use in consumer products (window treatments)
- One source reported human or environmental exposure data
- OECD use codes for this chemical included AC5e
- One source indicated EU production was over 1,5000 tonnes (high production volume). Two other sources listed it as a low production volume chemical.

- According to these sources, this chemical has been used in: unsaturated polyesters, rigid polyurethane foams and paper; rigid PU polyols, wire coatings and wool; polymers and plastic products; and household curtains
- No sources mentioned this chemical in the context of supply chain issues, use trends over time, alternatives, or laws or regulations.

O.14.5 20566-35-2 2-(2-HYDROXYETHOXY)ETHYL 2-HYDROXYPROPYL 3,4,5,6-TETRABROMOPHTHALATE

- This chemical was referenced in four sources
- No sources mentioned product testing data
- No sources cited use in consumer or children's products
- OECD use codes for this chemical included AC2a and AC13a
- One source indicated EU production was 100 to 1,000 tonnes (medium production volume).
- According to these sources, this chemical has been used in: rigid PU foams for appliances; rigid PUF (unspecified); and plastic products, as an intermediate
- Two sources mentioned this chemical in the context of use trends over time, one addressed alternatives, and one addressed end of life issues.

O.14.6 13810-83-8 TETRABROMOPHTHALIC ACID

- This chemical was referenced in two sources
- No sources mentioned product testing data or human or environmental exposure data
- No use information was reported for this chemical
- No production information was reported for this chemical
- No sources mentioned this chemical in the context of use trends over time, alternatives, end of life issues, or laws or regulations.

O.14.7 7415-86-3 1,2-BENZENEDICARBOXYLIC ACID, 1,2-BIS(2,3-DIBROMOPROPYL) ESTER

- This chemical was referenced in one source
- No sources mentioned product testing data or human or environmental exposure data
- OECD use codes for this chemical included AC5e
- One source indicated this chemical is used in polyester fibers in textiles
- No production information was reported for this chemical
- No sources mentioned this chemical in the context of use trends over time, alternatives, end of life issues, or laws or regulations.

O.14.8 632-58-6 TETRACHLOROPHTHALIC ACID

- This chemical was referenced in one source
- No sources mentioned product testing data or human or environmental exposure data
- No use information was reported for this chemical
- No production information was reported for this chemical
- No sources mentioned this chemical in the context of use trends over time, alternatives, end of life issues, or laws or regulations.

O.14.9 27581-13-1 2,3,4,5-TETRABROMOBENZOIC ACID

- This chemical was referenced in one source
- No sources mentioned product testing data or human or environmental exposure data
- No use information was reported for this chemical
- No production information was reported for this chemical
- No sources mentioned this chemical in the context of use trends over time, alternatives, end of life issues, or laws or regulations.

O.15 LITERATURE SOURCES USED

Arvaniti, O. S., & Kalantzi, O. I. (2021). Determinants of flame retardants in non-occupationally exposed individuals - A review. *Chemosphere, 263*.

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Blum, A. D., Birnbaum, L., Weber, R., Kannan, K., Rich, D., Lucas, D., . . . Hanson, S. (2010). *Halogenated Flame Retardants in Consumer Products: Do the Fire Safety Benefits Justify the Health and Environmental Risks?* Paper presented at the 5th International Symposium on Brominated Flame Retardants (BFR2010), Kyoto, Japan.

Bolinius, D. J., Sobek, A., Löf, M. F., & Undeman, E. (2018). Evaluating the consumption of chemical products and articles as proxies for diffuse emissions to the environment. *Environmental Science: Processes & Impacts, 20*(10), 1427-1440.

Commission for Environmental Cooperation. (2015). *Enhancing Trilateral Understanding of Flame Retardants and Their Use in Manufactured Items: Supply Chain Analysis of Select Flame Retardants Contained in Manufactured Items that are used in Indoor Environments*.

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APPENDIX P | POLYHALOGENATED TRIAZINES

P.1 SUMMARY OF CHEMICALS – PHTS

CAS NUMBER	CHEMICAL NAME	SYNONYMS	CDR, TSCA (ACTIVE), TRI, OR HPCDS	TSCA (INACTIVE) OR INT'L REGISTRIES	LITERATURE REVIEW SOURCES	INITIAL DATA SOURCE SCORE	OFR QSUR SCORE	TOTAL COUNT OF PATENTS	% POST-2000 PATENTS	% POST-2000 PATENTS WITH OFR KEYWORDS IN ABSTRACT	U.S./ INT'L REGULATORY LISTS
All	**Across all 6 PHTs**		**1**	**2**	**5**	**NA**	**6**	**4**	**NA**	**NA**	**2**
114955-21-4	diethyl (4,6-dichloro-1,3,5-triazin-2-yl)phosphonate		0	0		low	0.8933	6	33%	100%	
25713-60-4	2,4,6-Tris-(2,4,6-tribromophenoxy)-1,3,5-triazine	FR-245	2	1	7	high	0.9307	748	91%	91%	2
52434-59-0	1,3,5-Triazine, 2,4,6-tris(2,3-dibromopropoxy)-		0	0	1	high	0.9018	24	100%	100%	
52434-90-9	1,3,5-Tris(2,3-dibromopropyl)-1,3,5-triazine-2,4,6(1H,3H,5H)-trione		0	1	5	high	0.8779	4,603	79%	86%	3
57829-89-7	1-(2,3-dibromopropyl)-3,5-di(prop-2-en-1-yl)-1,3,5-triazinane-2,4,6-trione		0	0	2	high	0.9345	0			
75795-16-3	1,3-bis(2,3-dibromopropyl)-5-(prop-2-en-1-yl)-1,3,5-triazinane-2,4,6-trione		0	0	1	high	0.9345	0			

P.1.1 OVERVIEW

There are six substances in the OFR class "Polyhalogenated triazines" (PHTs), with key attributes described in the Summary by Chemical table (For field definitions and color scheme, see Guide to Summary Tables, Appendix B.1). Two of these substances are reported on one or more chemical inventories we reviewed. One (CAS No. 25713-60-4) is an active TSCA Inventory[39] substances and the other (CAS No. 52434-90-9) appears on other (non-U.S.) inventories, including those of the EU, Canada, Japan, and China. The remaining five substances do not appear on any inventories we reviewed.

During our literature search, we found that five of the six PHT chemicals are referenced in the literature, including CAS No. 25713-60-4, the active TSCA Inventory substance.

Databases with chemical production and use information were also searched (see Chapter 3). Patent data from PubChem reported information on four PHT chemicals. A total of five PHT chemicals had information from the literature review. Three chemicals (half of the class) had no industrial or regulatory reporting, but had either patent, or literature records.

P.1.2 INDUSTRY PRODUCTION AND USE

Most of the available information from EPA focuses on a single substance within the PHT class, CAS No. 25713-60-4, the active TSCA Inventory substance.

For the most recent year available from EPA, 2015, U.S. industry reported a single report of activity, but the nature of that activity (manufacturing or importing) was not disclosed. Likewise, total reported production volume (manufacturing plus importing) in 2015 was not disclosed.

Prior data from EPA indicate that in 2010 and 2011, the reported PV for CAS No. 25713-60-4 was 1.2 million and 760,000 pounds, respectively. No PV for the chemical was reported for 2013, 2014, or 2015. There were also no reports submitted for any PHTs in either 2006 or 1998.

Industry identified a single processing and use activity for CAS No. 25713-60-4 in 2015: as a flame retardant for plastic material and resin manufacturing. This was classified as a commercial use; no consumer or children's product uses were indicated.

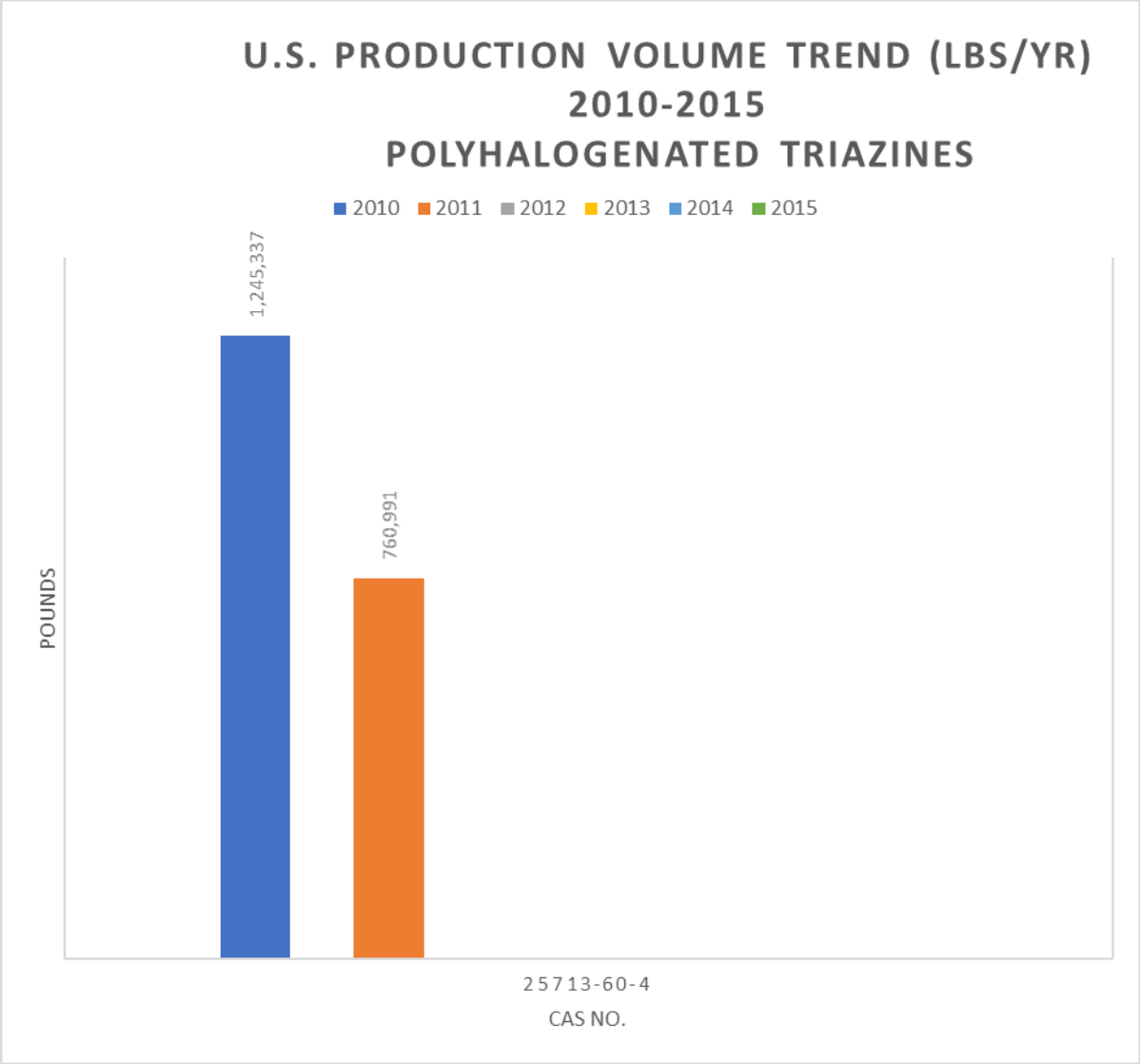
Over the period 2015-2019, no reports were submitted under the Toxics Release Inventory (TRI) for any PHT chemicals.

P.1.3 USE IN CONSUMER AND CHILDREN'S PRODUCTS

The states of Washington and Oregon require industry to report on chemicals of concern in products intended for use by children that are sold in those states. The reporting tool used by Washington and Oregon is known as the High Priority Chemicals Data System (HPCDS). According to data available

[39] The Toxic Substances Control Act (TSCA) Inventory is a list of chemical substances manufactured in or imported to the United States at some time since June 2006. For more information see https://www.epa.gov/tsca-inventory/tsca-inventory-notification-active-inactive-rule.

from the HPCDS, manufacturers have not reported use of PHTs in children's products over the period 2013-2020.



PHTs have been cited in eight of the 187 literature sources reviewed. Among the five PHTs cited, chemicals appearing in the greatest number of these sources include: CAS No. 25713-60-4 (7 sources) and CAS No. 54234-90-9 (5 sources). One source cited concentrations of 0.01 to 1.9 percent for CAS No. 54234-90-9 across sampled electrical and electronic products.

Uses for PHTs identified through the literature review (as described in Chapter 3) include:

CAS No. 25713-60-4: Consumer electric and electronic products; high-impact polystyrene polymers and acrylonitrile butadiene styrene polymers; polyurethane, polyolefin, polyvinyl chloride (PVC) and synthetic rubber; high-impact polystyrene.

CAS No. 52434-90-9: High-impact polystyrene, acrylonitrile butadiene styrene polymers; thermoplastic resins, thermoset resins, textiles, adhesives, circuit boards, electronic enclosures, paper, thermal insulation for building applications; electrical power boards and adaptors, televisions, and other household appliances.

P.2 PHTS ON NATIONAL AND INTERNATIONAL INVENTORIES AND REGISTRIES

Chemicals in class: 6

- 1 active on TSCA Inventory (recently manufactured/imported in U.S.)[40]
- 0 inactive on TSCA Inventory (no longer manufactured/imported in U.S.)
- 5 not on TSCA Inventory (never manufactured/imported in U.S.)

PHTS ON THE TSCA ACTIVE INVENTORY	
25713-60-4	2,4,6-Tris-(2,4,6-tribromophenoxy)-1,3,5-triazine
PHTS ON THE TSCA INACTIVE INVENTORY	
None	

OTHER PHTS ON INTERNATIONAL REGISTRIES		
52434-90-9	1,3,5-Tris(2,3-dibromopropyl)-1,3,5-triazine-2,4,6(1H,3H,5H)-trione	Canada DSL, EU Reach, Japan CSCL, China IECSC

P.3 U.S. MANUFACTURING AND IMPORTING ACTIVITY, 2015

NUMBER OF REPORTS BY ACTIVITY TYPE						
PHTS	MANUFACTURE	IMPORT	BOTH MANUFACTURE AND IMPORT	NOT SPECIFIED	CBI	TOTAL
25713-60-4	--	--	--	--	--	1

Source: U.S. EPA, CDR (2016).

P.4 U.S. MANUFACTURING AND IMPORTING VOLUMES, 2015

REPORTED VOLUMES BY ACTIVITY TYPE					
PHTS	MANUFACTURE	IMPORT	PRODUCTION VOLUME (MANUFACTURE + IMPORT)	USED	EXPORTED
25713-60-4	--	--	--	--	--

-- data CBI or otherwise not disclosed
Source: U.S. EPA, CDR (2016).

[40] "Active" indicates that U.S. manufacturing or importing activity has been reported since June 2006.

P.5 U.S. PRODUCTION VOLUME TRENDS, 2012-2015

PHTS	PV 2015	PV 2014	PV 2013	PV 2012
25713-60-4	--	--	--	--

-- data CBI or otherwise not disclosed
PV = manufacturing plus importing
Source: U.S. EPA, CDR (2016).

P.6 TYPE OF PROCESSING OR USE REPORTS, 2015

	NUMBER OF REPORTS							
PHTS	Processing as a Reactant	Processing—Incorporation Into Article	Processing—Incorporation Into Formulation, Mixture, or Reaction Product	Processing—Repackaging	Use—Non-Incorporative Activities	CBI	NKRA	Grand Total
25713-60-4			1					1

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

P.7 INDUSTRIAL USE REPORTS, 2015

NUMBER OF REPORTS																							
PHTS	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
25713-60-4																1							1
USED AS FLAME RETARDANT																							
25713-60-4																1							1

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

P.8 INDUSTRIAL FUNCTION REPORTS, 2015

NUMBER OF REPORTS															
PHTS	Adhesives and Sealant Chemicals	Cartridge Materials	Finishing Agents	Flame Retardants	Industrial Manufacturing	Intermediates	Lubricants and Lubricant Additives	Other	Paint Additives and Coating Additives Not Described by Other Categories	Plasticizers	Processing Aids, Not Otherwise Listed	Processing Aids, Specific to Petroleum Production	CBI	NKRA	Grand Total
25713-60-4				1											1

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

P.9 INDUSTRIAL SECTOR REPORTS, 2015

NUMBER OF REPORTS: POLYHALOGENATED TRIAZINES																								
PHT	Adhesive Manufacturing	All Other Basic Inorganic Chemical Manufacturing	All Other Basic Organic Chemical Manufacturing	All Other Chemical Product and Preparation Manufacturing	Computer and Electronic Product Manufacturing	Construction	Custom Compounding of Purchased Resin	Electrical Equipment, Appliance, and Component Manufacturing	Fabricated Metal Product Manufacturing	Furniture and Related Product Manufacturing	Miscellaneous Manufacturing	Oil and Gas Drilling, Extraction, and Support Activities	Paint and Coating Manufacturing	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Petroleum Lubricating Oil and Grease Manufacturing	Plastic Material and Resin Manufacturing	Plastics Product Manufacturing	Rubber Product Manufacturing	Synthetic Rubber Manufacturing	Textiles, Apparel, and Leather Manufacturing	Transportation Equipment Manufacturing	CBI	NKRA	Grand Total
ALL INDUSTRIAL FUNCTIONS																								
Total																	1							1
25713-60-4																	1							1
USED AS FLAME RETARDANT																								
Total																	1							1
25713-60-4																	1							1

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

P.10 CONSUMER AND CHILDREN'S PRODUCT USE REPORTS, 2015

NUMBER OF REPORTS						
PHTS	COMMERCIAL	CONSUMER	CONSUMER AND COMMERCIAL	NKRA	CBI	TOTAL
25713-60-4	1					1

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

PHTS	CHILDREN'S PRODUCT USE	NKRA	OTHER USE	TOTAL
25713-60-4			1	1

NKRA = not known or reasonably ascertainable
Source: U.S. EPA, CDR (2016).

P.11 TOXIC RELEASE INVENTORY REPORTS

TRI-REPORTABLE CHEMICALS	
None	

TOTAL PRODUCTION-RELATED WASTE REPORTED							
PHTS		2015	2016	2017	2018	2019	GRAND TOTAL
None	No. of Reports						
	Pounds of waste managed						

Source: U.S. EPA, Toxics Release Inventory (2015-2019).

TRI Reports by Industry:

None

P.12 HIGH PRIORITY CHEMICALS DATA SYSTEM REPORTS

NUMBER OF REPORTS BY YEAR											
PHTS		2012	2013	2014	2015	2016	2017	2018	2019	2020[1]	TOTAL
CAS No	Total										
	FR										
	Conc>0.1%										

[1] Partial year reporting.
Source: Interstate Chemicals Clearinghouse (2021).

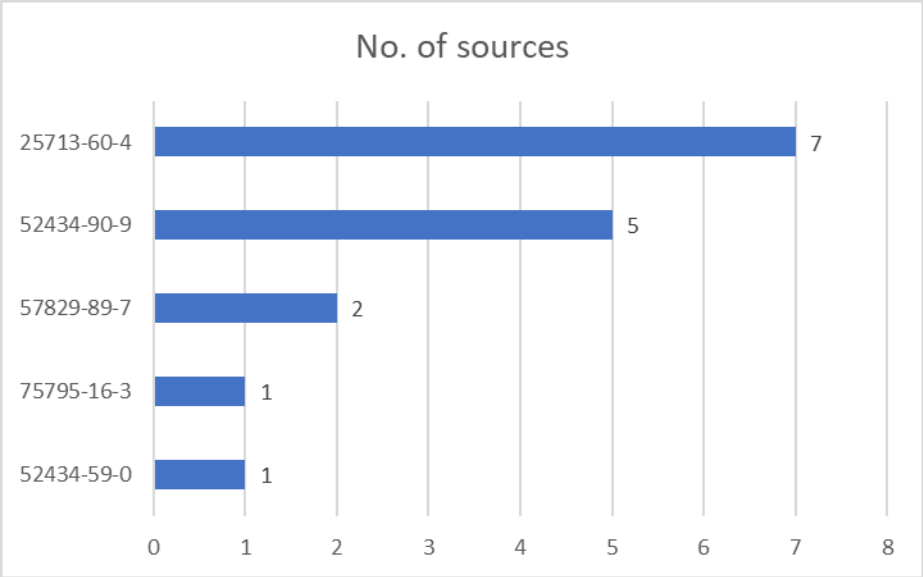
P.13 PATENT COUNTS FROM PUBCHEM

		Count of Patents				Count of Patents with OFR keywords in Abstract				Count of Patents with OFR keywords in both Title and Abstract			
CAS Number	PubChem CID	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total	1980 and before	1981-2000	2001 and after	Total
25713-60-4	91820	7	62	679	**748**	5	37	438	**480**	2	28	281	**311**
52434-59-0	11039892	0	0	24	**24**	0	0	17	**17**	0	0	17	**17**
52434-90-9	103634	18	926	3,659	**4,603**	15	141	964	**1,120**	11	109	592	**712**
57829-89-7	101683998	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
75795-16-3	101683997	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
114955-21-4	54227866	0	4	2	**6**	0	0	1	**1**	0	0	0	**0**

Source: PubChem Patent Data (See Exhibit 2-1 in main report and on OFR_universe_wPCPy_10122021.xlsx, tab 'Patent Info by CID' in Supplemental Information)

P.14 PHTS CITED IN LITERATURE REVIEW

A literature search was conducted to identify sources with information about chemicals in this OFR class (see Chapter 3). PHTs are mentioned or referenced in 8 of the 187 sources reviewed.



In this section, the following OECD use codes for chemicals are listed according to the internationally harmonized functional, product and article use categories:[41]

- AC13e. Plastic articles (hard). Furniture & furnishings, including furniture coverings. Examples: Computer casing.

P.14.1 25713-60-4 2,4,6-TRIS-(2,4,6-TRIBROMOPHENOXY)-1,3,5-TRIAZINE

- This chemical was referenced in seven sources
- Two sources reported product testing, and one of these included concentration data:
    - Present in 8 of 13 plastic products tested (mainly electric and electronic equipment acquired in 2012) at 0.01 to 1.9 percent
- Testing included both consumer and children's products
- Three sources reported human or environmental exposure data
    - OECD use codes for this chemical included AC13e.

[41] Source: OECD (2017).

- According to these sources, this chemical has been used in:
    - Electrical power boards, adaptors, televisions, toys, and other household appliances (a heat sealer, a vacuum cleaner, and an electrical plastic ornament).
    - High-impact polystyrene polymers and in acrylonitrile butadiene styrene polymers.
    - Curtains and other textiles.
    - Adhesives, circuit boards, electronic enclosures, paper, and thermal insulation for building applications.
- Once source indicates this is a high production volume chemical (>1 million pounds per year).
- One source mentioned use trends over time.

P.14.2 52434-90-9 1,3,5-TRIS(2,3-DIBROMOPROPYL)-1,3,5-TRIAZINE-2,4,6(1H,3H,5H)-TRIONE

- This chemical was referenced in five sources
- One source reported product testing, but did not include concentration data.
- Two sources reported human or environmental exposure data.
- OECD use codes for this chemical included AC13e
- According to these sources, this chemical has been used in:
    - Polyurethane, polyolefin, polyvinyl chloride (PVC) and synthetic rubber
    - Thermoplastic resins, thermoset resins, textiles, adhesives, circuit boards, electronic enclosures, paper, thermal insulation for building applications.
    - Polyurethane, polyolefin, polyvinyl chloride (PVC) and synthetic rubber.
- Once source indicates this is a low production volume chemical (>100,000 pounds per year).
- One source mentioned use trends over time.

P.14.3 57829-89-7 1-(2,3-DIBROMOPROPYL)-3,5-DI(PROP-2-EN-1-YL)-1,3,5-TRIAZINANE-2,4,6-TRIONE

- This chemical was referenced in two sources.
- One source reported human or environmental exposure data.
- Reported uses include:
    - Plastic consumer products purchased in Switzerland

P.14.4 75795-16-3 1,3-BIS(2,3-DIBROMOPROPYL)-5-(PROP-2-EN-1-YL)-1,3,5-TRIAZINANE-2,4,6-TRIONE

- This chemical was referenced in one source.
- No specific information about the chemical was provided

P.14.5 52434-59-0 1,3,5-TRIAZINE, 2,4,6-TRIS(2,3-DIBROMOPROPOXY)-

- This chemical was referenced in one source.
- One source mentioned use trends over time

P.15 LITERATURE SOURCES USED

Ballesteros-Gómez, A., de Boer, J., & Leonards, P. E. G. (2014). A novel brominated triazine-based flame retardant (TTBP-TAZ) in plastic consumer products and indoor dust. *Environmental Science & Technology, 48*(8), 4468-4474.

Bolinius, D. J., Sobek, A., Löf, M. F., & Undeman, E. (2018). Evaluating the consumption of chemical products and articles as proxies for diffuse emissions to the environment. *Environmental Science: Processes & Impacts, 20*(10), 1427-1440.

Gustavsson, J., Fischer, S., Ahrens, L., & Wiberg, K. (2017). Replacement substances for the brominated flame retardants PBDE, HBCDD, and TBBPA.

Miyake, Y., Tokumura, M., Nakayama, H., Wang, Q., Amagai, T., Ogo, S., . . . Ogawa, K. (2017). Simultaneous determination of brominated and phosphate flame retardants in flame-retarded polyester curtains by a novel extraction method. *Science of The Total Environment, 601*, 1333-1339.

U.S. EPA. Design for the Environment Program. (2014). An Alternatives Assessment for the Flame Retardant Decabromodiphenyl Ether (DecaBDE).

Wypych, A., & Wypych, G. (2021). *Databook of Flame Retardants*. Toronto: ChemTech Publishing.

Wypych, G. (2021). *Handbook of Flame Retardants*. Toronto: ChemTech Publishing.

Zuiderveen, E. A. R., Slootweg, J. C., & de Boer, J. (2020). Novel brominated flame retardants - A review of their occurrence in indoor air, dust, consumer goods and food. *Chemosphere, 255*, 126816.

APPENDIX Q | ESTIMATED OFR HISTORICAL PRODUCTION VOLUME

Q.1 OVERVIEW

As noted in Section 4.2.1 and elsewhere, U.S. production volume (manufacturing plus importing) for TSCA Inventory chemicals is reported to EPA under the Chemical Data Reporting (CDR) rule, and its predecessor Inventory Update Rule (IUR). Reporting under these programs has occurred in 2016, 2012, 2006, 2002, and 1998. Reporting data was obtained for all periods except 2002.[42]

In the 2016 and 2012 reporting periods, industry reported actual manufacturing and importing volumes, and these can be summed to obtain totals by chemical. In 2016, PV data was reported for 2015, 2014, 2013, and 2012. In 2012, PV data was reported for 2011 and 2010. Thus, annual data reported in a consistent fashion are available for 2010-2016. These data are presented in Section 4 and throughout the main report.

Prior to the 2012 reporting period, industry reported production volume by indicating their production volume range, using ranges provided by EPA. As a result, reporting data from these periods are not strictly comparable with data from subsequent reporting periods.

In the 2006 and 1998 reporting period, EPA reported the aggregate PV by chemical, in ranges. In 1998 the PV ranges were the same as in 2006, with the exception of the lowest range. In 1998 the lowest range was 10,000 to 500,000 pounds, whereas in 2006 it was <500,000 pounds. As a result, the midpoint for this range is 300,000 pounds in 1998, versus 250,000 pounds in 2006.

We estimated PV by chemical using the midpoint of each range, as follows:

2006 PV RANGES AND MIDPOINTS USED TO CALCULATE AGGREGATE PV BY CHEMICAL

PV RANGE	MIDPOINT USED
< 500,000 pounds	250,000 pounds
500,000 to <1 million pounds	750,000 pounds
1 million to <10 million pounds	5.5 million pounds
10 million to <50 million pounds	30.0 million pounds
50 million to <100 million pounds	75.0 million pounds
100 million to <500 million pounds	300.0 million pounds

1998 PV RANGES AND MIDPOINTS USED TO CALCULATE AGGREGATE PV BY CHEMICAL

PV RANGE	MIDPOINT USED
10,000 to 500,000 pounds	300,000 pounds
500,000 to <1 million pounds	750,000 pounds
1 million to <10 million pounds	5.5 million pounds
10 million to <50 million pounds	30.0 million pounds
50 million to <100 million pounds	75.0 million pounds
100 million to <500 million pounds	300.0 million pounds

[42] EPA was unable to provide the 2002 data for this study.

Using these midpoints, we estimated total production by chemical for 2005 and 1997. Total PV for all OFRs is estimated at 752 million pounds in 2005 and 1,398.7 million pounds in 1997.

Q.2 ESTIMATED PV FOR OFR CHEMICALS, 2005

OFR CLASS AND CAS NO.	ESTIMATED PV 2005
POLYHALOGENATED ALICYCLES	60,000,000
3194-55-6	30,000,000
77-47-4	30,000,000
POLYHALOGENATED ALIPHATIC CHAINS	66,500,000
36483-57-5	250,000
61788-76-9	30,000,000
63449-39-8	30,000,000
68527-01-5	750,000
68527-02-6	5,500,000
POLYHALOGENATED BENZENE ALIPHATICS AND FUNCTIONALIZED	30,000,000
84852-53-9	30,000,000
POLYHALOGENATED BISPHENOL ALIPHATICS AND FUNCTIONALIZED	305,750,000
21850-44-2	5,500,000
25327-89-3	250,000
79-94-7	300,000,000
POLYHALOGENATED CARBOCYCLES	11,000,000
115-27-5	5,500,000
13560-89-9	5,500,000
POLYHALOGENATED DIPHENYL ETHERS	75,000,000
1163-19-5	75,000,000
POLYHALOGENATED ORGANOPHOSPHATES	121,000,000
115-96-8	750,000
13674-84-5	30,000,000
13674-87-8	30,000,000
140-08-9	30,000,000
19186-97-1	250,000
6294-34-4	30,000,000
POLYHALOGENATED PHENOL DERIVATIVES	30,000,000
118-79-6	30,000,000
POLYHALOGENATED PHENOL-ALIPHATIC ETHER	6,500,000
3278-89-5	250,000
37853-59-1	5,500,000
7347-19-5	750,000
POLYHALOGENATED PHTHALATES/BENZOATES/IMIDES	46,500,000

OFR CLASS AND CAS NO.	ESTIMATED PV 2005
117-08-8	5,500,000
26040-51-7	5,500,000
32588-76-4	5,500,000
632-79-1	30,000,000
Grand Total	752,250,000

Q.3 ESTIMATED PV FOR OFR CHEMICALS, 1997

OFR CLASS AND CAS NO.	ESTIMATED PV 1997
POLYHALOGENATED ALICYCLES	60,600,000
25637-99-4	300,000
3194-55-6	30,000,000
3322-93-8	300,000
77-47-4	30,000,000
POLYHALOGENATED ALIPHATIC CHAINS	71,900,000
3234-02-4	300,000
3296-90-0	5,500,000
36483-57-5	300,000
61788-76-9	30,000,000
63449-39-8	30,000,000
68527-01-5	5,500,000
79-27-6	300,000
POLYHALOGENATED BISPHENOL ALIPHATICS AND FUNCTIONALIZED	261,300,000
21850-44-2	5,500,000
25327-89-3	5,500,000
4162-45-2	300,000
79-94-7	250,000,000
POLYHALOGENATED BENZENES	300,000
87-82-1	300,000
POLYHALOGENATED CARBOCYCLES	11,300,000
115-27-5	5,500,000
13560-89-9	5,500,000
1770-80-5	300,000
POLYHALOGENATED DIPHENYL ETHERS	766,800,000
1163-19-5	750,000,000
32534-81-9	5,500,000
32536-52-0	5,500,000
58965-66-5	5,500,000

OFR CLASS AND CAS NO.	ESTIMATED PV 1997
68928-80-3	300,000
POLYHALOGENATED ORGANOPHOSPHATES	119,000,000
115-96-8	5,500,000
115-98-0	300,000
125997-20-8	5,500,000
13674-84-5	30,000,000
13674-87-8	30,000,000
140-08-9	30,000,000
19186-97-1	300,000
33125-86-9	300,000
38051-10-4	5,500,000
6145-73-9	300,000
6294-34-4	5,500,000
76025-08-6	300,000
76649-15-5	5,500,000
POLYHALOGENATED PHENOL DERIVATIVES	30,000,000
118-79-6	30,000,000
POLYHALOGENATED PHENOL-ALIPHATIC ETHER	6,550,000
20217-01-0	300,000
3278-89-5	750,000
37853-59-1	5,500,000
POLYHALOGENATED PHTHALATES/BENZOATES/IMIDES	71,000,000
117-08-8	5,500,000
26040-51-7	5,500,000
32588-76-4	30,000,000
632-79-1	30,000,000
Grand Total	1,398,750,000

APPENDIX R | REGULATORY FACT SHEETS

R.1 LEGAL TRENDS FACT SHEET: STATE OF ALASKA

Relevant Law or Regulations:

Name	Toxic-Free Firefighters and Children Act
Citation	HB 27
Status	Pending legislation
Date	Introduced February 20, 2019
Description	Beginning January 1, 2020, would prohibit manufacturing, selling, offering for sale, or distributing a consumer product that contains a chemical that retards flame production if the chemical contains… 1. An organohalogenated flame retardant, organophosphorus flame retardant, organonitrogen flame retardant, or nanoscale material-based flame retardant; or 2. Antimony Would require manufacturers to place a label on consumer products that states whether the product contains or does not contain a chemical that retards flame production. Would authorize the Department of Environmental Conservation to participate in an interstate chemicals clearinghouse to learn about flame retardant chemicals used in consumer products.
Category	• Restricts use of OFRs • Requires reporting or data sharing
Relevant Products	Consumer products
Relevant OFRs	All OFRs
Implementing Agency	Alaska Department of Environmental Conservation
Link to text	https://www.akleg.gov/basis/Bill/Text/31?Hsid=HB0027A
Additional information:	

R.2 LEGAL TRENDS FACT SHEET: STATE OF CALIFORNIA

Relevant Law or Regulations:

Name	Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65)
Citation	
Status	Existing law
Date	Enacted November 5, 1986, effective January 1, 1987
Description	• Prohibits businesses from knowingly discharging or releasing chemicals known to cause cancer or reproductive toxicity into water • Requires businesses to provide warnings about significant exposures to chemicals that cause cancer, birth defects, or other reproductive harm • Requires a list of chemicals known to the state to cause cancer or reproductive toxicity to be published by March 1, 1987, which must be updated at least once a year
Category	• Identifies OFR as hazardous chemicals • Requires reporting or data sharing
Relevant Products	
Relevant OFRs	Listed Proposition 65 chemicals: <u>Polyhalogenated aliphatic chains</u> • 2,3-Dibromo-1-propanol (96-13-9) • Chlorinated paraffins (Average chain length, C12; approximately 60 percent chlorine by weight) (108171-26-2) • 2,2-Bis(bromomethyl)-1,3-propanediol (3296-90-0) <u>Polyhalogenated carbocycles</u> • Mirex (2385-85-5) • Chlorendic acid (115-28-6) <u>Polyhalogenated bisphenol aliphatics and functionalized</u> • Tetrabromobisphenol A (79-94-7) <u>Polyhalogenated organophosphates</u> • Tris(1,3-dichloro-2-propyl) phosphate (TDCPP) (13674-87-8) • Tris(2,3-dibromopropyl) phosphate (126-72-7) • Tris(2-chloroethyl) phosphate (115-96-8) <u>Polyhalogenated benzenes</u> • Polybrominated biphenyls <u>Polyhalogenated diphenyl ethers</u> • Pentabromodiphenyl ether mixture [DE-71 (technical grade)]
Implementing Agency	California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA)
Link to text	https://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=HSC&division=20.&title=&part=&chapter=6.6.&article

Additional information:	https://oehha.ca.gov/media/downloads/proposition-65/p65chemicalslistsinglelisttable2021p.pdf : Proposition 65 chemicals

Name	An act to add Chapter 10 (commencing with Section 108920) to Part 3 of Division 104 of the Health and Safety Code, relating to toxic substances.
Citation	AB 302
Status	Existing law
Date	Enacted August 11, 2003, ban effective January 1, 2008
Description	Prohibits manufacturing, processing, and distributing products or flame-retarded parts of products containing more than one tenth of one percent of pentaBDE or octaBDE by mass, beginning January 1, 2008 • Does not apply to: ○ The processing of metallic recyclables Requires the Senate Office of Research to submit recommendations regarding PBDE regulations, including findings and rulings by the EU, by March 1, 2004
Category	• Restricts use of OFRs • Requires additional research of OFRs
Relevant Products	All/ any products or flame-retarded parts of products
Relevant OFRs	Polyhalogenated diphenyl ethers • Pentabrominated diphenyl ether (PentaBDE) • Octabrominated diphenyl ether (OctaBDE)
Implementing Agency	
Link to text	https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=200320040AB302
Additional information:	Effective date of the ban on octaBDE and pentaBDE was moved to 2006 by AB 2587

Name	An act to amend Sections 108921 and 108922 of the Health and Safety Code, relating to toxic substances.
Citation	AB 2587
Status	Existing law
Date	Adopted September 21, 2004, ban effective July 1, 2006
Description	This law prohibits manufacturing, processing, and distributing products or flame-retarded parts of products containing more than one tenth of one percent of pentaBDE or octaBDE, beginning June 1, 2006 • Does not apply to: ○ Products containing small amounts of PBDEs produced or used for scientific research on the effects of PBDEs
Category	Restricts use of OFRs
Relevant Products	All/ any products or flame-retarded parts of products
Relevant OFRs	Polyhalogenated diphenyl ethers • Pentabromodiphenyl ether (PentaBDE) • Octabromodiphenyl ether (OctaBDE)
Implementing Agency	
Link to text	http://www.leginfo.ca.gov/pub/03-04/bill/asm/ab_2551-2600/ab_2587_bill_20040921_chaptered.html
Additional information:	

Name	An act to add Sections 25252, 25252.5, 25253, 25254, 25255, and 25257 to the Health and Safety Code, relating to hazardous materials.
Citation	AB 1879
Status	Existing law
Date	Effective September 29, 2008
Description	• Establishes the Department of Toxic Substances Control (DTSC) • Requires the department to establish a process for identifying and prioritizing chemicals of concern in consumer products by January 1, 2011 • Requires the department to establish a process to limit exposure or reduce levels of hazard posed by these chemicals of concern • Requires the establishment of a Green Ribbon Science Panel to advise the department • Requires the establishment of a procedure to protect information submitted to the department that is considered to be a trade secret
Category	Identifies OFR as hazardous chemicals
Relevant Products	Consumer products
Relevant OFRs	Listed Candidate Chemicals: <u>Polyhalogenated alicycles</u> • 1,2,5,6,9,10-Hexabromocyclododecane (HBCD) (mixed isomers) (3194-55-6) • 1,2-Dibromo-4-(1,2-dibromoethyl)cyclohexane (3322-93-8) • Hexabromocyclododecane (25637-99-4) <u>Polyhalogenated benzenes</u> • 1,3,5-Tribromobenzene (626-39-1) • 2,2',4,4',5,5'-Hexabromobiphenyl (BB 153) (59080-40-9) • Hexabromobenzene (87-82-1) • Hexabromobiphenyl (59536-65-1) • Polybrominated biphenyls, PBBs (59536-65-1)
Relevant OFRs	Listed Candidate Chemicals: <u>Polyhalogenated aliphatic chains</u> • 2,2-Bis(bromomethyl)propane-1,3-diol (3296-90-0) • 2,3-Dibromo-1-propanol (96-13-9) • Alkanes, C10-13, chloro (Short Chain Chlorinated Paraffins) (85535-84-8) • Alkanes, C10-21, chloro (84082-38-2) • Alkanes, C14-16, chloro (1372804-76-6) • Alkanes, C14-17, chloro (85535-85-9) • Alkanes, C18-20, chloro (106232-85-3) • Alkanes, C18-28, chloro (85535-86-0) • Alkanes, C6-18, chloro (68920-70-7) • Alkanes, chloro (61788-76-9) • Chlorinated Paraffins (C12, 60% Chlorine) (108171-26-2) • Paraffin oils, chloro (85422-92-0) • Paraffin waxes and Hydrocarbon waxes chlorinated (63449-39-8) • Tribromoneopentylalcohol (1522-92-5)

Relevant OFRs	Listed Candidate Chemicals: <u>Polyhalogenated organophosphates</u> • 2,2-Bis(chloromethyl)trimethylene bis[bis(2- chloroethyl)phosphate] (38051-10-4) • Tetrakis(2-chloroethyl)dichloroisopentyl diphosphate (FRV66) (38051-10-4) • Tris(1,3-dichloro-2-propyl) phosphate (TDCPP) (13674-87-8) • Tris(1-chloro-2-propyl)phosphate (TCPP) (13674-84-5) • Tris(2,3-dibromopropyl) phosphate (126-72-7) • Tris(2,3-dichloro-1-propyl)phosphate (66108-37-0) • Tris(2-chloroethyl)phosphate (TCEP) (115-96-8) • Tris(tribromoneopentyl)phosphate (19186-97-1) <u>Polyhalogenated phthalates/benzoates/imides</u> • 2,3,4,5,-Tetrabromobenzoic acid (TBBA) (27581-13-1) • 2-Ethyl-1-hexyl-2,3,4,5-tetrabromobenzoate (EH-TBB) (183658-27-7) • Bis(2-ethyl-1-hexyl)tetrabromophthalate (TBPH) (26040-51-7) • N,N'-Ethylenebis(tetrabromophthalimide) (32588-76-4) • Tetrabromophthalic anhydride (632-79-1) • Tetrachlorophthalic anhydride (117-08-8) <u>Polyhalogenated benzene aliphatics and functionalized</u> • 2,3,5,6-Tetrabromo-p-xylene (23488-38-2) • Decabromodiphenylethane (DBDPE) (84852-53-9) • Pentabromoethylbenzene (PBEB) (85-22-3) • Pentabromotoluene (87-83-2) <u>Polyhalogenated phenol-aliphatic ether</u> • 2,3-Dibromopropyl-2,4,6-tribromophenyl ether (DPTE) (35109-60-5) • Allyl 2,4,6-tribromophenyl ether (ATE) (3278-89-5) • 1,2-Bis(2,4,6-tribromophenoxy)ethane (BTBPE) (37853-59-1) <u>Polyhalogenated phenol derivatives</u> • 2,4,6-Tribromophenol (118-79-6) • 2,4-Dibromophenol (615-58-7) • Pentabromophenol (608-71-9) • 1,1'-Sulfonylbis[3,5-dibromo-4-(2,3-dibromopropoxy) benzene (42757-55-1) <u>Polyhalogenated triazines</u> • 2,4,6-Tris(2,4,6-tribromophenoxy)-1,3,5-triazine (25713-60-4) • Tris-(2,3-dibromopropyl) isocyanurate (52434-90-9) <u>Polyhalogenated carbocycles</u> • anti-isomer of Dechlorane Plus (135821-74-8) • Bis(hexachlorocyclopentadieno)cyclooctane (Dechlorane Plus) (13560-89-9) • Chlorendic acid (115-28-6) • Hexachlorocyclopentadienyl-dibromocyclooctane (HCDBCO) (51936-55-1) • syn-isomer of Dechlorane Plus (135821-03-3)

Relevant OFRs	Listed Candidate Chemicals: Polyhalogenated diphenyl ethers • BDE 153 (68631-49-2) • BDE 209 (1163-19-5) • BDE 47 (5436-43-1) • BDE 99 (60348-60-9) • Benzene, 1,1'-oxybis-, hexabromo deriv. (36483-60-0) • Benzene, 1,1'-oxybis-, pentabromo deriv. (32534-81-9) • Benzene, 1,1'-oxybis-, tetrabromo deriv. (40088-47-9) • Brominated flame retardants (1163-19-5) • Octabromodiphenyl ether (32536-52-0) • PCB 183 (189084-68-2) • Polybrominated diphenyl ethers (PBDEs) congeners (68928-80-3) • 4-Bromophenyl phenyl ether, Bromophenyl Phenyl Ether (101-55-3) Polyhalogenated benzene alicycles • Octabromotrimethylphenylindane (OBIND) (155613-93-7) Polyhalogenated bisphenol aliphatics and functionalized • Tetrabromobisphenol A (TBBPA) (79-94-7) • Tetrabromobisphenol A bis(2,3-dibromopropyl) ether (21850-44-2) • Tetrabromobisphenol A bis(2-hydroxyethyl) ether (4162-45-2) • Tetrabromobisphenol A diallyl ether (25327-89-3)
Implementing Agency	California Department of Toxic Substances Control
Link to text	https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=200720080AB1879
Additional information:	https://dtsc.ca.gov/scp/what-are-the-safer-consumer-products-regulations/ : DTSC regulations that develop a process to establish a list of Candidate Chemicals and identify Priority Products https://calsafer.dtsc.ca.gov/cms/search/?type=Chemical : List of Candidate Chemicals https://dtsc.ca.gov/scp/priority-products/#:~:text=The%20regulation%20to%20list%20Children%27s%20Foam-Padded%20Sleeping%20Products,announced%20after%20the%20have%20completed%20the%20APA%20process.: "The regulation to list Children's Foam-Padded Sleeping Products with TDCPP or TCEP as a Priority Product became effective on July 1, 2017."

Name	An act to add Section 13108.1 to the Health and Safety Code, relating to fire safety.
Citation	AB 127
Status	Existing law
Date	Effective October 5, 2013
Description	Requires the State Fire Marshal, in consultation with the Bureau of Electronic and Appliance Repair, Home Furnishings, and Thermal Insulation, to review the flammability standards for building insulation materials and determine whether some of these standards can only be met with the addition of chemical flame retardants. The State Fire Marshall may propose updated insulation flammability standards by July 1, 2015 if they deem it appropriate.
Category	Requires additional research
Relevant Products	Insulation materials
Relevant OFRs	All OFRs
Implementing Agency	The Office of the State Fire Marshal, in consultation with the Bureau of Electronic and Appliance Repair, Home Furnishings, and Thermal Insulation
Link to text	https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB127
Additional information:	http://web1a.esd.dof.ca.gov/Documents/bcp/1617/FY1617_ORG3540_BCP488.pdf : State Fire Marshal did not think it was appropriate to propose updated flammability standards Flammability Standards for Building Insulation Materials

Name	An act to add Section 19094 to the Business and Professions Code, relating to business.
Citation	SB 1019
Status	Existing law
Date	Effective September 30, 2014
Description	• Requires manufacturers of covered products to label whether the covered product contains flame retardant chemicals in levels above 1,000 ppm • Requires manufacturers of covered products to retain documentation regarding whether flame retardants were added to a covered product • Requires the bureau to provide the Department of Toxic Substances Control with a selection of samples from covered products that manufacturers claim have no added flame retardants for testing
Category	• Identifies OFRs as hazardous chemicals • Requires reporting or data sharing
Relevant OFRs	All OFRs
Relevant Products	Flexible polyurethane foam or upholstered or reupholstered furniture
Implementing Agency	Bureau of Household Goods and Services (formerly the Bureau of Electronic and Appliance Repair, Home Furnishings, and Thermal Insulation (BEARHFTI))
Link to text	http://www.leginfo.ca.gov/pub/13-14/bill/sen/sb_1001-1050/sb_1019_bill_20140930_chaptered.html
Additional information:	Flame retardant chemicals are defined as "any chemical or chemical compound for which a functional use is to resist or inhibit the spread of fire. Flame retardant chemicals include, but are not limited to, halogenated, phosphorous-based, nitrogen-based, and nanoscale flame retardants, flame retardant chemicals listed as "designated chemicals" pursuant to Section 105440 of the Health and Safety Code, and any chemical or chemical compound for which "flame retardant" appears on the substance Safety Data Sheet (SDS) pursuant to Section 1910.1200(g) of Title 29 of the Code of Federal Regulations." https://bhgs.dca.ca.gov/laws/hfti_regs.pdf : BEARHFTI regulations

Name	An act to add Article 5.5 (commencing with Section 19100) to Chapter 3 of Division 8 of the Business and Professions Code, relating to business.
Citation	AB 2998
Status	Existing law
Date	Enacted September 29, 2018, ban effective January 1, 2020
Description	Prohibits the sale and distribution of new, not previously owned, juvenile products, mattresses, and upholstered furniture containing covered flame retardants at levels above 1,000 ppm, effective January 1, 2020 Prohibits custom upholsterers from repairing upholstered furniture using replacement components that contain covered flame retardant chemicals at levels above 1,000 ppm, effective January 1, 2020 Does not apply to: • Electronic components of juvenile products, mattresses, reupholstered furniture, upholstered furniture, or any associated casing for those electronic components • Upholstered or reupholstered furniture components other than cover fabrics, barrier materials, resilient filling materials, and decking materials • Thread or fiber when used for stitching mattress components together. • Components of adult mattresses other than foam Requires the International Sleep Products Association to conduct a survey of mattress producers, and submit a survey report to the bureau by January 31, 2020 Requires the International Sleep Products Association to conduct a new survey of mattress producers, including, but not limited to, registered mattress producers, and submit a survey report to the bureau on or before January 31, 2023, and every three years thereafter • The bureau shall post the reports on its Internet Web site
Category	• Restricts use of OFRs • Requires reporting or data sharing
Relevant Products	• Children's products • Mattresses • Upholstered Furniture
Relevant OFRs	All OFRs
Implementing Agency	Bureau of Household Goods and Services (formerly the Bureau of Electronic and Appliance Repair, Home Furnishings, and Thermal Insulation)
Link to text	https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB2998
Additional information:	https://bhgs.dca.ca.gov/laws/hfti_regs.pdf: BEARHFTI regulations

R.3 LEGAL TRENDS FACT SHEET: STATE OF DELAWARE

Relevant Law or Regulations:

Name	An Act to Amend Title 6 of the Delaware Code Relating to the Prohibition of Harmful Flame Retardants
Citation	House Bill 77
Status	Pending legislation
Date	Introduced January 19, 2021

Description	Would prohibit the manufacture, sale, or distribution of children's products, upholstered furniture used in residences, and mattresses that contain harmful flame retardant chemicals.
	• Does not apply to:
	  ○ the sale of used products;
	  ○ furniture purchased for public use in public facilities;
	  ○ thread or fiber used for stitching mattress components;
	  ○ children's products that are not primarily intended for use in the home;
	  ○ products being transferred to a vehicle at a warehouse or distribution center for delivery in another state; or
	  ○ electronic components

Category	Restricts use of OFRs
Relevant Products	• Children's products • Upholstered furniture • Mattresses
Relevant OFRs	Polyhalogenated phthalates/benzoates/imides • TBB (183658-27-7) • TBPH (26040-51-7) Polyhalogenated aliphatic chains • Chlorinated paraffins (85535-84-8) Polyhalogenated diphenyl ethers • Decabromodiphenyl ether (1163-19-5) Polyhalogenated alicycles • HBCD (25637-99-4) Polyhalogenated bisphenol aliphatics and functionalized • TBBPA (79-94-7) Polyhalogenated organophosphates • TDCPP (13674-87-8) • TCEP (115-96-8) • TCPP (13674-84-5)
Link to text	https://legis.delaware.gov/BillDetail?legislationId=48303

Additional information:	A children's product is defined as a "product designed for residential use by infants and children under 12 years old. This includes "a bassinet, booster seat, changing pad, floor play mat, highchair pad, infant bouncer, infant carrier, infant seat, infant swing, infant walker, nursing pad, nursing pillow, playpen side pad, playard, portable hook-on chair, stroller, mattress, and children's nap mat." Electronic enclosures inside a product and consumer electronic products are not considered children's products.

R.4 LEGAL TRENDS FACT SHEET: STATE OF GEORGIA

Relevant Law or Regulations:

Name	To amend Chapter 15 of Title 25 of the Official Code of Georgia Annotated, relating to other safety inspections and regulations, so as to prohibit the use of certain chemical flame retardants; to provide for procedures, conditions, and limitations; to repeal conflicting laws; and for other purposes.
Citation	HB 40
Status	Pending legislation
Date	Effective January 1, 2021

Description	Subsection (b) would prohibit the sale, distribution, manufacture, and import of covered products that contain certain chemical flame retardants in a total weight that exceeds 1,000 parts per million for any component part of the covered product. Every three years, the office will review and recommend other flame retardants that should be prohibited under subsection (b) of this code, provided that the chemical is known to…
	• harm the normal development of a fetus or child or cause developmental toxicity;
	• cause cancer, genetic damage, or reproductive harm;
	• disrupt the endocrine system; damage the nervous system, immune system, or an organ, or cause the systemic toxicity; or
	• is found to be persistent, bioaccumulative, and toxic.
	
	If the office finds that a flame retardant meets these conditions, it will restrict the manufacture, sale, distribution, or importation of any children's product or residential upholstered furniture that contains the flame retardant within nine months of the determination. Additionally, the flame retardant will be subject to subsection (b).
	• Exceptions: If the flame retardant is in an engineered nanoobject, it is prohibited, regardless of the amount of the chemical in the product
	• Does not apply to:
	  ○ Motor vehicles, watercraft, aircraft, all-terrain vehicles, off-highway motorcycles, or any component parts; or
	  ○ The sale or purchase of any previously owned product containing a chemical flame retardant prohibited under this Code section.

Category	Restricts use of OFRs
Relevant Products	Bedding Carpeting Children's product Residential upholstered furniture Window treatment

Relevant OFRs	Polyhalogenated organophosphates • Tris(1,3-dichloro-2-propyl) phosphate (TDCPP) (13674-87-8) • Tris(1-chloro-2-propyl) phosphate (TCPP) (13674-84-5) • Tris(2-chloroethyl)phosphate (TCEP) (115-96-8) Polyhalogenated alicycles • Hexabromocyclododecane (HBCD) (25637-99-4) Polyhalogenated phthalates/benzoates/imides • Tetrabutylphosphonium hydroxide (TBPH) (26040-51-7) • Tetrabromobenzotriazole (TBB) (183658-27-7) Polyhalogenated aliphatic chains • Chlorinated paraffins (85535-84-8) Polyhalogenated diphenyl ethers • Octabromodiphenyl ether (OctaBDE) (32536-52-0) • Pentabromodiphenyl ether (PentaBDE) (32534-81-9) Polyhalogenated bisphenol aliphatics and functionalized • Tetrabromobisphenol A (TBBPA) (79-94-7)
Implementing Agency	Office of Insurance and Safety Fire Commissioner
Link to text	https://www.legis.ga.gov/legislation/58829
Additional information:	

R.5 LEGAL TRENDS FACT SHEET: STATE OF HAWAII

Relevant Law or Regulations:

Name	Polybrominated diphenyl ethers: A bill for an act relating to polybrominated diphenyl ethers
Citation	HB 2013
Status	Existing law
Date	Adopted in 2004, ban effective January 1, 2006
Description	It is the purpose of this Act to phase out the use of PBDEs in the State of Hawaii. Prohibits the manufacture, processing, or distribution of products or flame-retarded parts of a product containing more than one tenth of one per cent, by mass, of pentaBDE, octaBDE, or any other chemical formulation that is part of these classifications • Does not apply to: ○ The processing of metallic recyclables containing pentaBDE or octaBDE
Category	Restricts use of OFRs
Relevant Products	All/any products or flame-retarded parts of a product • Examples given: electrical casings, polyurethane foam, commercial textiles, upholstered products, home furniture, telephone handsets, housings for televisions, computers, stereos, and other products such as plastic furniture and toys.
Relevant OFRs	Polyhalogenated diphenyl ethers • pentaBDE • octaBDE
Implementing Agency	
Link to text	https://www.capitol.hawaii.gov/session2004/bills/HB2013_cd1_.htm
Additional information:	

Name	Supporting The Phase Out Of Production And Importation Of Decabromodiphenl [sic] Ether (DecaBDE) And All Other Polybrominated Diphenyl Ethers (PBDEs) In The United States.
Citation	HCR 235/ SR 107
Status	Existing law
Date	Adopted March 10, 2010
Description	States Hawaii's support of the industry phase-out of decaBDE and all other PBDEs in the United States, and encourages the EPA to continue to its efforts to end decaBDE importation into the United States
Category	Support of OFR restriction
Relevant Products	
Relevant OFRs	Polyhalogenated diphenyl ethers • Decabromodiphenyl ether (DecaBDE) • All other PBDEs
Implementing Agency	
Link to text	https://www.capitol.hawaii.gov/session2010/Bills/HCR235_.PDF
Additional information:	

R.6 LEGAL TRENDS FACT SHEET: STATE OF ILLINOIS

Relevant Law or Regulations:

Name	The Brominated Fire Retardant Prevention Act: An Act concerning safety.
Citation	HB 2572
Status	Existing law
Date	Effective January 1, 2006
Description	Prohibits the manufacture, process, or distribution in commerce of a product or a flame-retarded part of a product containing more than 0.1% of pentaBDE or octaBDE • Does not apply to: o The sale by a business, charity, or private party of any used product containing PBDE. o The distribution in commerce of original equipment manufacturer replacement service parts manufactured prior to the effective date of the law. o The processing of recycled material containing pentaBDE or octaBDE in compliance with applicable State and federal laws. Requires a study of decaBDE
Category	• Restricts use of OFRs • Requires additional research of OFRs
Relevant Products	All/any products or flame-retarded parts of a product
Relevant OFRs	Polyhalogenated diphenyl ethers • Decabromodiphenyl ether (DecaBDE) (studied, but not prohibited) • Octabromodiphenyl ether (OctaBDE) • Pentabromodiphenyl ether (PentaBDE)
Implementing Agency	Illinois Department of Public Health
Link to text	https://www.ilga.gov/legislation/fulltext.asp?DocName=&SessionId=50&GA=94&DocTypeId=HB&DocNum=2572&GAID=8&LegID=18516&SpecSess=&Session=
Additional information:	http://www.epa.state.il.us/reports/decabde-study/ : Report on Alternatives to the Flame Retardant DecaBDE Because of these concerns and the fact that a significant number of alternatives are affordable, available and have better toxicity rankings than DecaBDE, the Agency recommends that the Governor support a managed state-level phase-out of several DecaBDE's uses.

R.7 LEGAL TRENDS FACT SHEET: STATE OF IOWA

Relevant Law or Regulations:

Name	An Act relating to the control of certain chemicals in public drinking water supply systems and consumer products, making penalties applicable, and including effective date provisions
Citation	House File 293
Status	Pending legislation
Date	Introduced January 28, 2021, effective January 1, 2022

Description	Would prohibit the sale or distribution of upholstered furniture that contains more than one-tenth of one percent of a flame retardant chemical or more than one-tenth of one percent of a mixture that includes flame-retardant chemicals in its fabric, other covering, or cushioning material
	• Does not apply to:
	  ○ Used upholstered furniture
	  ○ Upholstered furniture purchased for public use in public facilities, including schools, jails, and hospitals, that meets generally accepted flammability standards for seating furniture used in public occupancies
	  ○ New upholstered furniture that was imported into the state or purchased/acquired for sale or distribution prior to January 1st, 2022

Category	Restricts use of OFRs
Relevant Products	Upholstered furniture
Relevant OFRs	All OFRs
Implementing Agency	Iowa Department of Public Health
Link to text	https://www.legis.iowa.gov/legislation/BillBook?ba=HF293&ga=89
Additional information:	"Flame retardant chemical" includes halogenated, phosphorus-based, nitrogen-based, and nanoscale flame retardants and any chemical for which "flame retardant" appears on the substance safety sheet.

R.8 LEGAL TRENDS FACT SHEET: STATE OF MAINE

Relevant Law or Regulations:

Name	Restrictions on sale and distribution of brominated flame retardants: An Act To Reduce Contamination of Breast Milk and the Environment from the Release of Brominated Chemicals in Consumer Products
Citation	LD 1790/ HP 1312
Status	Existing law
Date	Enacted April 14, 2004, ban effective January 1, 2006
Description	Prohibits selling or distributing a product containing more than 1% of the penta or octa mixtures of PBDEs, effective January 1, 2006 • Does not apply to: ○ Used products Requires the department to develop a report regarding the regulation of brominated flame retardants
Category	• Restricts use of OFRs • Requires additional research of OFRs
Relevant Products	All/any products
Relevant OFRs	Polyhalogenated diphenyl ethers • pentaBDE • octaBDE
Implementing Agency	Maine Department of Environmental Protection
Link to text	http://www.mainelegislature.org/legis/bills/bills_121st/chapters/PUBLIC629-1.asp
Additional information:	**Amended by LD 1658**

Name	An Order Promoting Safer Chemicals In Consumer Products And Services
Citation	12 FY 06/07
Status	Existing Law
Date	Enacted February 22, 2006
Description	Requires the Maine Department of Environmental Protection to develop a report on decaBDE alternatives by July 1, 2006 Establishes the Governor's Task Force to Promote Safer Chemicals in Consumer Products
Category	Requires additional research of OFRs
Relevant Products	All/ any products
Relevant OFRs	DecaBDE and alternatives
Implementing Agency	Maine Department of Environmental Protection
Link to text	http://lldc.mainelegislature.org/Open/Exec/ExecutiveOrders/72_Baldacci/2006-07/eo_2006-07no12.pdf
Additional information:	http://www.theic2.org/article/download-pdf/file_name/Maine_DEP_presentation_1-13-11.pdf

Name	An Act To Protect Pregnant Women and Children from Toxic Chemicals Released into the Home
Citation	LD 1658
Status	Existing law
Date	Effective June 14, 2007

Description	• Prohibits selling and distributing products containing more than 0.1% of the penta or octa mixtures of PBDEs
	• Repeals requirement for DEP to submit a report on brominated flame retardants annually
	• Prohibits manufacturing, selling, or distributing mattresses, mattress pads, and residential upholstered furniture that have plastic fibers containing the deca mixture, effective January 1, 2008
	  ○ Does not apply to:
	  ▪ Transportation vehicles or products or parts for use in transportation vehicles or transportation equipment
	  ▪ Products or equipment used in industrial or manufacturing processes
	  ▪ Electronic wiring and cable used for power transmission
	• Prohibits manufacturing, selling, or distributing televisions or computers that have plastic housing containing the deca mixture, effective January 1, 2010
	  ○ Does not apply to:
	  ▪ Transportation vehicles or products or parts for use in transportation vehicles or transportation equipment
	  ▪ Products or equipment used in industrial or manufacturing processes
	  ▪ Electronic wiring and cable used for power transmission
	• Requires manufacturers of products containing PBDEs under this law to notify sellers of the requirements of this law
	• The DEP must develop a program to assist retailers in identifying products that may have PBDEs
	• Requires manufacturers of products or product components containing any brominated flame retardant to provide written notice to the department effective January 1, 2010
	  ○ The notice must contain information regarding the amount of brominated flame retardant in each unit of the product and the total amount of brominated flame retardant sold in the last year
	• Authorizes the department to participate in the establishment and implementation of a regional, multistate clearinghouse
	• Requires the department to submit a report regarding regulation of brominated flame retardants every 2 years

Category	• Restricts use of OFRs • Requires additional research of OFRs • Requires reporting or data sharing
Relevant Products	All/ any products
Relevant OFRs	<u>Polyhalogenated diphenyl ethers</u> • decaBDE • octaBDE • pentaBDE
Implementing Agency	Maine Department of Environmental Protection

Link to text	https://legislature.maine.gov/legis/bills/bills_123rd/billtexts/HP116701.asp
Additional information:	

Name	Kid-Safe Products Act: An Act To Protect Children's Health and the Environment from Toxic Chemicals in Toys and Children's Products
Citation	LD 2048
Status	Existing law
Date	Effective July 18, 2008

Description	• Requires the department to publish a list of chemicals of high concern by January 1, 2010
	• Requires the commissioner to designate at least 2 priority chemicals by January 1, 2011
	• Requires the commissioner to review the list of chemicals of high concern at least every 3 years
	• Requires manufacturers or distributors of children's products containing a priority chemical to report the use of the chemical to the department, within 180 days of the chemical being identified as a priority chemical
	• Provides authority to prohibit the manufacture, sale, or distribution of a children's product containing a priority chemical if…
	  ○ Distribution of the product exposes children and vulnerable populations to the priority chemical
	  ○ One or more safety alternatives to the priority chemical are available at a comparable cost
	• Does not apply to:
	  ○ Used products
	  ○ Priority chemicals used in industry or manufacturing
	  ○ Motor vehicles or watercraft or their component parts (excluding detachable car seats)
	  ○ Priority chemicals generated solely as combustion by-products or that are present in combustible fuels
	  ○ Retailers, unless that retailer knowingly sells a children's product containing a priority chemical after its effective date of prohibition, for which that retailer received a prior notification
	  ○ Mercury added products
	  ○ Service provider whose name appears on a telecommunications device, unless they are the actual manufacturer of the device
	  ○ Food and beverage packaging, unless the product is intentionally marketed/ made for use for children under 3 years old

Category	• Identifies OFRs as hazardous chemicals • Requires reporting or data sharing
Relevant OFRs	
Relevant Products	Children's products
Implementing Agency	Maine Department of Environmental Protection
Link to text	http://www.mainelegislature.org/legis/bills/bills_123rd/chappdfs/PUBLIC643.pdf
Additional information:	**Amended by LD 1129** https://www.maine.gov/sos/cec/rules/06/chaps06.htm#:~:text=Rule%20Chapters%20for%20the%20Department%20of%20Environmental%20Protection,%20%20%28Repealed%29%20%2037%20more%20rows%20 : Department of Environmental Protection Rule Chapters.

Name	An Act To Clarify Maine's Phaseout of Polybrominated Diphenyl Ethers
Citation	LD 1568
Status	Existing law
Date	Enacted April 6, 2010

Description	• Prohibits the manufacture, sale, or distribution of products manufactured from recycled shipping pallets containing decaBDE
	  ○ Does not apply to:
	  ▪ Shipping pallets made from recycled shipping pallets
	• Prohibits the manufacture, sale, or distribution of shipping pallets containing decaBDE, beginning January 1, 2012
	  ○ Does not apply to:
	  ▪ Shipping pallets made from recycled shipping pallets
	  ○ Can obtain an exemption to sell or distribute shipping pallets containing decaBDE until January 1, 2013 if the commissioner finds that…
	  ▪ A safer alternative to decaBDE doesn't exist
	  ▪ A shipping pallet fails to meet applicable fire standards
	  ▪ Additional time is needed to test or produce shipping pallets with alternatives
	• Requires manufacturers or owners of shipping pallets subject to the restrictions of this act to submit a report to the department certifying compliance by January 1, 2013, and annually thereafter
	• Requires manufacturers of products containing PBDEs restricted under this act to notify persons selling their products, beginning January 1, 2013
	• Prohibits replacing decaBDE with a chemical alternative that contains more than 0.1% of chemicals that meet the following criteria:
	  ○ Has been identified as or meets the criteria for identification as a persistent, bioaccumulative and toxic chemical by the United States Environmental Protection Agency;
	  ○ Is a brominated or chlorinated flame retardant; or
	  ○ Creates another chemical as a breakdown product through degradation or metabolism that has been identified as persistent, bioaccumulative, and toxic
	• Allows chemical replacements that contain an amount of halogenated organic chemical containing the element fluorine equal or less than 0.2%
	• Does not prohibit the sale, distribution, or use of:
	  ○ Used products
	  ○ Products if the presence of polybrominated diphenyl ether is due solely to the use of recycled material (except for recycled shipping pallets); or
	  ○ Replacement parts that contain the "octa" or "penta" mixtures if the parts are for use in a product manufactured before January 1, 2006

Category	• Restricts use of OFRs • Requires reporting or data sharing
Relevant Products	Shipping pallets
Relevant OFRs	<u>Polyhalogenated diphenyl ethers</u> • decaBDE

Implementing Agency	Maine Department of Environmental Protection
Link to text	http://www.mainelegislature.org/legis/bills/bills_124th/chappdfs/PUBLIC610.pdf
Additional information:	https://digitalmaine.com/cgi/viewcontent.cgi?article=1065&context=dep_docs : Report commissioned by the DEP pursuant to this act. Finds that there are safer alternatives to the use of decaBDE in pallets

Name	An Act To Provide the Department of Environmental Protection with Regulatory Flexibility Regarding the Listing of Priority Chemicals
Citation	LD 1129
Status	Existing law
Date	Enacted June 13, 2011

Description	• Renames the list of chemicals of high concern (established in LD 2048) to "the list of chemicals of concern", effective September 1, 2011
	  ○ A chemical may be included on this list if it is…
	  ▪ A carcinogen, a reproductive or developmental toxicant or an endocrine disruptor;
	  ▪ Persistent, bioaccumulative and toxic; or
	  ▪ Very persistent and very bioaccumulative
	  ○ Requires the department to review the list and remove any chemical that is not used in applicable consumer products by January 1, 2012
	• Requires the department to publish a list of no more than 70 chemicals of high concern by January 1, 2010, whose criteria for inclusion are that they are:
	  ○ On the list of chemicals of concern; and
	  ○ Found to be present in human blood, including umbilical cord blood, breast milk, urine or other bodily tissues or fluids;
	  ○ Found to be present in household dust, indoor air, or drinking water or elsewhere in the home environment; or
	  ○ Present in a consumer product used or present in the home
	• A chemical of high concern is eligible for designation as a priority chemical, effective July 1, 2012, if the chemical:
	  ○ On the list of chemicals of high concern; and
	  ○ Has been found to be present in human blood, including umbilical cord blood, breast milk, urine or other bodily tissues or fluids;
	  ○ Has been found to be present in household dust, indoor air, or drinking water or elsewhere in the home environment; or
	  ○ Is present in a consumer product used or present in the home
	• Manufacturers and distributors need to report the use of priority chemicals in children's products if the priority chemical is present in an amount greater than a de minimis level
	  ○ Notice must identify the children's product, the amount of such chemicals in each unit of children's product and the intended purpose of the chemicals in the children's product.
	• The manufacture, sale, or distribution of a children's product may be prohibited if it contains a priority chemical in an amount greater than a de minimis level
	• Does not apply to:
	  ○ Children's products that would not come into direct contact with a child's skin or mouth, such as inaccessible components of children's products
	  ○ A priority chemical that occurs in a product component only as a contaminant if the manufacturer had in place a manufacturing control program and exercised due diligence to minimize the presence of the contaminant in the component

Category	• Identifies OFRs as hazardous chemicals • Requires reporting or data sharing
Relevant Products	Children's products

Relevant OFRs	Listed Chemicals of High Concern: Polyhalogenated bisphenol aliphatics and functionalized • Tetrabromobisphenol A (79-94-7) Polyhalogenated diphenyl ethers • 2,2',3,3',4,4',5,5',6,6'-Decabromodiphenyl ether; BDE-209 (1163-19-5) Polyhalogenated alicycles • Hexabromocyclododecane (25637-99-4) Listed Priority Chemicals: Polyhalogenated diphenyl ethers • decaBDE (1163-19-5) Polyhalogenated alicycles • hexabromocyclododecane (HBCD) (25637-99-4)
Implementing Agency	Maine Department of Environmental Protection
Link to text	http://www.mainelegislature.org/legis/bills/getPDF.asp?paper=HP0841&item=3&snum=125
Additional information:	De minimus level means: • "For a chemical of high concern or priority chemical that is an intentionally added chemical in a component of a children's product, the practical quantification limit; or • For a chemical of high concern or priority chemical that is a contaminant present in a component of a children's product, a concentration of 100 parts per million." https://www.maine.gov/sos/cec/rules/06/chaps06.htm#:~:text=Rule%20Chapters%20for%20the%20Department%20of%20Environmental%20Protection,%20%20%28Repealed%29%20%2037%20more%20rows%20 : Department of Environmental Protection Rule Chapters. See Ch. 880 and 889 https://www.maine.gov/dep/safechem/childrens-products/highconcern/index.html#:~:text=Chemicals%20of%20High%20Concern%20%20%20%20CAS,Dicyclohexyl%20phthalate%3B%20DCHP%20%2032%20more%20rows%20 : List of Chemicals of High Concern https://www1.maine.gov/dep/safechem/childrens-products/priority/index.html : List of Priority Chemicals https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fwww.maine.gov%2Fsos%2Fcec%2Frules%2F06%2F096%2F096c889.docx&wdOrigin=BROWSELINK : Designation of decaBDE and HBCD as priority products

Name	An Act To Protect Firefighters by Establishing a Prohibition on the Sale and Distribution of New Upholstered Furniture Containing Certain Flame retardant Chemicals
Citation	LD 182
Status	Existing law
Date	Effective August 2, 2017
Description	Prohibits selling or distributing upholstered furniture containing more than 0.1% of a flame retardant chemical or mixture in its covering or in its cushioning materials, as of January 1, 2019. Does not apply to: • Used upholstered furniture • Upholstered furniture purchased for public use in public facilities • New upholstered furniture purchased or acquired by a retailer or wholesaler prior to January 1, 2019
Category	Restricts use of OFRs
Relevant Products	Upholstered furniture
Relevant OFRs	All OFRS
Implementing Agency	Maine Department of Environmental Protection
Link to text	http://www.mainelegislature.org/legis/bills/getPDF.asp?paper=HP0138&item=9&snum=128
Additional information:	"'Flame-retardant chemical' includes, but is not limited to, halogenated, phosphorus-based, nitrogen-based and nanoscale flame retardants and any chemical or chemical compound for which 'flame retardant' appears on the substance safety data sheet required under 29 Code of Federal Regulations, Section 1910.1200(g) (2015)." **Amended by LD 1662** https://www.maine.gov/dep/safechem/flame-retardants/index.html

Name	An Act Regarding Maine's Sales Prohibition on Upholstered Furniture Treated with Flame-retardant Chemicals
Citation	LD 1662/ HP 1233
Status	Existing law
Date	Effective June 15, 2021
Description	Clarifies that Maine's sales prohibition on upholstered furniture treated with flame retardants does not apply to electronic components and associated electronic component casings of upholstered furniture If upholstered furniture delivered to a retailer in the state by the manufacturer of the upholstered furniture is subsequently determined to contain prohibited flame-retardant chemicals, the retailer is entitled to a full refund
Category	Restricts use of OFRs
Relevant Products	Upholstered furniture
Relevant OFRs	All OFRs
Implementing Agency	Maine Department of Environmental Protection
Link to text	http://www.mainelegislature.org/legis/bills/getPDF.asp?paper=HP1233&item=3&snum=130
Additional information:	

R.9 LEGAL TRENDS FACT SHEET: STATE OF MARYLAND

Relevant Law or Regulations:

Name	An act concerning Environment – Brominated Flame Retardants – Pentabrominated and Octabrominated Diphenyl Ether - Prohibition
Citation	HB 83
Status	Existing law
Date	Act effective October 1, 2005, ban effective October 1, 2008
Description	Prohibits manufacturing, processing, selling, or distributing new products or flame-retardant parts of products that contain more than one tenth of 1% of pentaBDE or octaBDE by mass, effective October 1, 2008 • Does not apply to: ○ Original equipment manufacturer replacement service parts or other products manufactured prior to October 1, 2008 Requires the Department of the Environment to report on the use and effects of decaBDE by January 1, 2007
Category	• Requires additional research of OFRs • Restricts use of OFRs
Relevant Products	All/any products or flame-retarded parts of a product
Relevant OFRs	Polyhalogenated diphenyl ethers • Octabrominated diphenyl ether • Pentabrominated diphenyl ether • Decabrominated diphenyl ether (studied but not prohibited)
Implementing Agency	Maryland Department of the Environment
Link to text	https://mgaleg.maryland.gov/2005rs/bills/hb/hb0083e.pdf
Additional information:	

Name	An act concerning Environment – Decabrominated Diphenyl Ether – Prohibitions
Citation	SB 556
Status	Existing law
Date	Effective October 1, 2010

Description	Prohibits manufacturing, leasing, selling, or distributing mattresses, residential upholstered furniture, and electronic/electrical equipment containing decaBDE, beginning December 31, 2010
	
	Prohibits manufacturing, leasing, selling, or distributing any product containing decaBDE, beginning December 31, 2012
	• Does not apply to the following products until December 31, 2013:
	  ○ Transportation equipment
	  ○ Military equipment
	  ○ Components of transportation or military equipment
	
	Law does not apply to:
	• Original manufacturer replacement service parts or other products manufactured prior to January 1, 2011
	• Vehicles and products for use in vehicles
	
	Law does not prohibit:
	• A retailer that is in possession of a product prohibited for manufacture, lease, sale, or distribution for sale or lease from selling, recycling, or otherwise disposing of a product that is in the retailer's or lessor's inventory on or after the date that the prohibition takes effect
	• Recycling products containing decaBDE
	• Selling, leasing, recycling, or disposing products containing recycled decaBDE
	• Transporting or storing prohibited product for later distribution outside the state

Category	Restricts use of OFRs
Relevant Products	All/any products
Relevant OFRs	Polyhalogenated diphenyl ethers • decaBDE
Implementing Agency	
Link to text	https://mgaleg.maryland.gov/2010rs/billfile/sb0556.htm
Additional information:	

Name	An act concerning Public Health – Child Care Products Containing Flame–Retardant Chemicals (TCEP) – Prohibition
Citation	HB 99
Status	Existing law
Date	Effective October 1, 2013
Description	Prohibits importing or selling child care products that contain more than one tenth of 1% of TCEP by mass and is intended for use by a child under the age of 3 years old. • Does not apply to: ○ The sale or distribution of a child care product that is resold or distributed by a consumer for consumer use Requires the Department of Health to adopt regulations to carry out this law by January 1, 2014
Category	Restricts use of OFRs
Relevant Products	Children's products
Relevant OFRs	Polyhalogenated organophosphates • tris (2–chloroethyl) phosphate (TCEP)
Implementing Agency	Maryland Department of Health and Mental Hygiene
Link to text	https://mgaleg.maryland.gov/mgawebsite/legislation/details/hb0099?ys=2013rs
Additional information:	http://www.dsd.state.md.us/comar/SubtitleSearch.aspx?search=10.19.07.* : Dept. of Health regulations "Child care product" means a consumer product intended for use by a child under the age of 3 years, including a baby product, toy, car seat, nursing pillow, crib mattress, and stroller.

Name	An act concerning Public Health – Child Care Products Containing Flame–Retardant Chemicals – TDCPP – Prohibition
Citation	HB 229
Status	Existing law
Date	Effective October 1, 2014
Description	Prohibits importing or selling child care products that contain more than one tenth of 1% of TDCPP by mass and is intended for use by a child under the age of 3 years old. • Does not apply to: ○ The sale or distribution of a child care product that is resold or distributed by a consumer for consumer use Requires the Department of Health to adopt regulations to carry out this law by January 1, 2015
Category	Restricts use of OFRs
Relevant Products	Children's products
Relevant OFRs	Polyhalogenated organophosphates • Tris (1,3-dichloro-2-propyl) phosphate (TDCPP)
Implementing Agency	Maryland Department of Health and Mental Hygiene
Link to text	https://mgaleg.maryland.gov/2014RS/bills/hb/hb0229T.pdf
Additional information:	http://www.dsd.state.md.us/comar/SubtitleSearch.aspx?search=10.19.07.* : Dept. of Health regulations "Child care product" means a consumer product intended for use by a child under the age of 3 years, including a baby product, toy, car seat, nursing pillow, crib mattress, and stroller.

Name	An act concerning Public Health – Products Containing a Flame–Retardant Chemical
Citation	HB 424/ SB 447
Status	Existing law
Date	Effective January 1, 2021

Description	Extends deadline for the Department of Health to adopt regulations to carry out TCEP and TDCPP ban from January 15, 2015 to June 1, 2021.
	
	Prohibits importing, selling any juvenile product, mattress, upholstered furniture, or reupholstered furniture containing more than 0.1% of flame retardant chemicals by mass
	
	• Does not apply to:
	  ○ An electronic component, or the casing for an electronic component, of a juvenile product, mattress, upholstered furniture, or reupholstered furniture
	  ○ A component of upholstered or reupholstered furniture other than cover fabric, barrier material, resilient filling material, and decking material
	  ○ Thread or fiber used for stitching mattress components together
	  ○ Except for foam, a component of an adult mattress
	
	Requires Department of Health to adopt regulations to carry out this law by June 1, 2021

Category	Restricts use of OFRs
Relevant Products	• Children's products • Mattresses • Upholstered and reupholstered furniture
Relevant OFRs	All OFRs
Implementing Agency	Maryland Department of Health
Link to text	https://mgaleg.maryland.gov/mgawebsite/Legislation/Details/sb0447?ys=2020rs
Additional information:	A flame retardant chemical is defined as "a chemical that is used to resist or inhibit the spread of fire or act as a synergist to chemicals that resist or inhibit the spread of fire, including any chemical for which the term "flame retardant" appears on a safety data sheet developed in accordance with 29 C.F.R. 1910.1200(g); and (ii) 1. contains one or more halogen elements, including fluorine, chlorine, bromine, or iodine; 2. contains one or more carbon elements and one or more phosphorus elements; 3. contains one or more carbon elements and one or more nitrogen elements; or 4. is a nanoscale chemical."

R.10 LEGAL TRENDS FACT SHEET: STATE OF MASSACHUSETTS

Relevant Law or Regulations:

Name	An act to protect children, families, and firefighters from harmful flame retardants
Citation	H 4900
Status	Existing law
Date	Effective January 1, 2021

Description	Prohibits manufacturers and retailers from selling, manufacturing, distributing, or importing covered products containing certain flame retardants which exceed 1,000 parts per million the total weight of the product or any component part.
	• Does not apply to:
	  ○ Inventory manufactured prior to December 31, 2021
	  ○ Motor vehicles, watercraft, aircraft, all-terrain vehicles, off-highway motorcycles
	  ○ Previously owned products
	  ○ Products containing recycled material
	
	Requires the Department of Environmental Protection, in consultation with the Toxics Use Reduction Institute at the University of Massachusetts at Lowell, to identify and recommend other chemical flame retardants to prohibit every 3 years
	Requires manufacturers of covered products containing prohibited chemical flame retardants to provide notice to retailers of the passage of this act by July 1, 2021
	The Department of Environmental Protection may establish a labeling program for any covered product that meets relevant fire safety standards and does not contain a prohibited chemical flame retardant.

Category	Restricts use of OFRs Requires additional research
Relevant Products	• Children's products • Residential upholstered furniture • Bedding • Carpeting • Window treatment

Relevant OFRs	Polyhalogenated organophosphates • Tris(1,3-dichloro-2-propyl)phosphate (TDCPP) (13674-87-8) • Tris(2-chloroethyl)phosphate (TCEP) (115-1496-8) • Tris (1-chloro-2-propyl) phosphate (TCPP) (13674-84-5) Polyhalogenated alicycles • Hexabromocyclododecane (HBCD) (25637-99-4) Polyhalogenated phthalates/benzoates/imides • Bis(2-Ethylhexyl)-3,4,5,6- tetrabromophthalate (TBPH) (26040-51-7) • 2-EthylhexYl-2,3,4,5-tetrabromobenzoate (TBB) (183658-27-7) Polyhalogenated aliphatic chains • Chlorinated paraffins (85535–84–8) Polyhalogenated diphenyl ethers • PentaBDE (32534-81-9) • OctaBDE (32536-52-0) Polyhalogenated bisphenol aliphatics and functionalized • Tetrabromobisphenol A (TBBPA) (79-94-7)
Implementing Agency	Massachusetts Department of Environmental Protection
Link to text	https://malegislature.gov/Bills/191/H4900
Additional information:	"Covered product" is defined as "bedding, carpeting, children's product, residential upholstered furniture or window treatment"

R.11 LEGAL TRENDS FACT SHEET: STATE OF MICHIGAN

Relevant Law or Regulations:

Name	Mary Beth Doyle PBDE Act (PBDE Compounds): An Act to amend 1994 PA 451, entitled "An act to protect the environment and natural resources of the state; to codify, revise, consolidate, and classify laws relating to the environment and natural resources of the state; to regulate the discharge of certain substances into the environment; to regulate the use of certain lands, waters, and other natural resources of the state; to prescribe the powers and duties of certain state and local agencies and officials; to provide for certain charges, fees, and assessments; to provide certain appropriations; to prescribe penalties and provide remedies; to repeal certain parts of this act on a specific date; and to repeal certain acts and parts of acts," (MCL 324.101 to 324.90106) by adding sections 14721, 14723, and 14724.
Citation	SB 1458
Status	Existing law
Date	Act effective January 3, 2005, ban effective June 1, 2006

Description	Prohibits the manufacture and distribution of products or materials containing more than 1/10 of 1% of octa-BDE.
	• Does not apply to:
	  ○ Original equipment manufacturer replacement service parts.
	  ○ Processing of recyclables containing octa-BDE in compliance with applicable federal, state, and local laws.
	
	Authorizes the Michigan Department of Environmental Quality to authorize a committee to study and determine the risk posed by the release of PBDEs, other than penta-BDE or octa-BDE, to human health and the environment.

Category	• Restricts use of OFRs • Requires additional research of OFRs
Relevant Products	All/ any products
Relevant OFRs	Polyhalogenated diphenyl ethers • Octabromodiphenyl ether (OctaBDE) • Other polybrominated diphenyl ether compounds (PBDEs) (studied but not prohibited)
Implementing Agency	Michigan Department of Environmental Quality
Link to text	http://www.legislature.mi.gov/documents/2003-2004/publicact/htm/2004-PA-0526.htm
Additional information:	https://www.newmoa.org/prevention/ic2/projects/chempolicy/legislationdocs/Michigan/MI_324.14721.doc https://www.michigan.gov/documents/deq/deq-tox-PBDEBackground_Paper-5-08_243976_7.pdf: MDEQ scientific review on PBDEs

Name	PBDE Compounds: An act to amend 1994 PA 451, entitled "An act to protect the environment and natural resources of the state; to codify, revise, consolidate, and classify laws relating to the environment and natural resources of the state; to regulate the discharge of certain substances into the environment; to regulate the use of certain lands, waters, and other natural resources of the state; to prescribe the powers and duties of certain state and local agencies and officials; to provide for certain charges, fees, and assessments; to provide certain appropriations; to prescribe penalties and provide remedies; to repeal certain parts of this act on a specific date; and to repeal certain acts and parts of acts," by amending sections 14701, 14702, 14703, and 14705 (MCL 324.14701, 324.14702, 324.14703, and 324.14705) and by amending the part heading for part 147 and by adding sections 14722 and 14725.
Citation	HB 4406
Status	Existing law
Date	Act effective January 3, 2005, ban effective June 1, 2006

Description	Prohibits the manufacture and distribution of products or materials containing more than 1/10 of 1% of penta-BDE, beginning June 1, 2006
	
	• Does not apply to:
	  ○ Original equipment manufacturer replacement parts.
	  ○ Processing of recyclables containing penta-BDE in compliance with applicable federal, state, and local laws.

Category	Restricts use of OFRs
Relevant Products	All/ any products
Relevant OFRs	Polyhalogenated diphenyl ethers • Pentabrominated diphenyl ether (pentaBDE)
Implementing Agency	Michigan Department of Environmental Quality
Link to text	http://www.legislature.mi.gov/documents/2003-2004/publicact/pdf/2004-PA-0562.pdf
Additional information:	https://www.newmoa.org/prevention/ic2/projects/chempolicy/legislationdocs/Michigan/MI_324.14721.doc

R.12 LEGAL TRENDS FACT SHEET: STATE OF MINNESOTA

Relevant Law or Regulations:

Name	Products Containing Polybrominated Diphenyl Ether
Citation	SF 2096
Status	Existing law
Date	Enacted May 8, 2007, ban effective January 1, 2008
Description	Prohibits manufacturing, processing, or distributing products or flame-retardant parts of products containing more than one tenth of one percent of pentabromodiphenyl ether or octabromodiphenyl ether by mass, beginning January 1, 2008 • Does not apply to: o Sale or distribution of used transportation vehicle with component parts containing PBDEs o Sale or distribution of any used transportation vehicle parts or new transportation vehicle parts manufactured before January 1, 2008, that contain PBDEs o Manufacture, sale, repair, distribution, maintenance, refurbishment, or modification of equipment containing PBDEs and used primarily for military or federally funded space program applications. o Sale or distribution by a business, charity, public entity, or private party of any used product containing PBDEs o Manufacture, sale, or distribution of new carpet cushion made from recycled foam containing more than one-tenth of one percent PBDE o Medical devices o Manufacture, sale, repair, distribution, maintenance, refurbishment, or modification of telecommunications equipment containing PBDEs used by entities eligible to hold authorization in the Public Safety Pool under Code of Federal Regulations, title 47, part 90. Requires the commissioner of the MPCA to review uses of decaBDE, availability of alternatives, and the potential harm of decaBDE and its alternatives. These findings must be reported by January 15, 2008
Category	• Restricts use of OFRs • Requires additional research of OFRs
Relevant Products	All/ any products
Relevant OFRs	Polyhalogenated diphenyl ethers • Pentabromodiphenyl ether • Octabromodiphenyl ether • Decabromodiphenyl ether (studied but not prohibited)
Implementing Agency	Minnesota Pollution Control Agency (MPCA)
Link to text	https://www.revisor.mn.gov/bills/text.php?number=SF2096&session=ls85&version=latest&session_number=0&session_year=2007

Additional information:	In-state retailers in possession of products on January 1, 2008, that are banned for sale under subdivision 1 may exhaust their stock through sales to the public.

Name	Toxic Free Kids Act
Citation	House File 2123
Status	Existing law
Date	Effective May 7th, 2009

Description	Requires the Department of Health to generate a list of chemicals of high concern by July 1, 2010, and to review and revise the list at least every three years
	• "Chemical of high concern" means a chemical identified on the basis of credible scientific evidence by a state, federal, or international agency as being known or suspected with a high degree of probability to:
	  ○ harm the normal development of a fetus or child or cause other developmental toxicity;
	  ○ cause cancer, genetic damage, or reproductive harm;
	  ○ disrupt the endocrine or hormone system;
	  ○ damage the nervous system, immune system, or organs, or cause other systemic toxicity;
	  ○ be persistent, bioaccumulative, and toxic; or
	  ○ be very persistent and very bioaccumulative
	
	Requires the department to publish a list of priority chemicals by February 1, 2011
	• Chemicals of high concern may be designated as priority chemicals if the chemical…
	  ○ has been identified as a high-production volume chemical by the United States Environmental Protection Agency; and
	  ○ meets any of the following criteria:
	  ▪ the chemical has been found through biomonitoring to be present in human blood, including umbilical cord blood, breast milk, urine, or other bodily tissues or fluids;
	  ▪ the chemical has been found through sampling and analysis to be present in household dust, indoor air, drinking water, or elsewhere in the home environment; or
	  ▪ the chemical has been found through monitoring to be present in fish, wildlife, or the natural environment

Description	Does not apply to: • Chemicals in used children's products • Priority chemicals used in the manufacturing process, but that are not present in the final product • Priority chemicals used in agricultural production • Motor vehicles or watercraft or their component parts, except that the use of priority chemicals in detachable car seats is not exempt • Priority chemicals generated solely as combustion by-products or that are present in combustible fuels • Retailers • Pharmaceutical products or biologics • A medical device • Food and food or beverage packaging, except a container containing baby food or infant formula • Consumer electronics products and electronic components, including but not limited to personal computers; audio and video equipment; calculators; digital displays; wireless phones; cameras; game consoles; printers; and handheld electronic and electrical devices used to access interactive software or their associated peripherals; or products that comply with the provisions of directive 2002/95/EC of the European Union • Outdoor sport equipment, including snowmobiles, all-terrain vehicles, personal watercraft, watercraft, and off-highway motorcycles, and all attachments and repair parts for all this equipment Authorizes the state to cooperate with other states in an interstate chemicals clearinghouse regarding chemicals in consumer products This bill covers a large range of topics. This description only focuses on Sections 47-50, which are relevant to OFRs
Category	• Identifies OFRs as hazardous chemicals • Requires reporting or data sharing
Relevant Products	
Relevant OFRs	Listed high concern chemicals: <u>Polyhalogenated alicycles</u> • Hexachlorocyclopentadiene (77-47-4) • Cyclododecane, 1,2,5,6,9,10-hexabromo- (3194-55-6) • Hexabromocyclododecane (25637-99-4) <u>Polyhalogenated bisphenol aliphatics and functionalized</u> • Tetrabromobisphenol A (79-94-7) • phenol, 4,4'-(1-methylethylidene)bis[2,6-dichloro- (2,2',6,6'-TETRACHLOROBISPHENOL A) (79-95-8) • benzene, 1,1'-(1-methylethylidene)bis[3,5-dibromo-4-(2,3-dibromopropoxy)- (21850-44-2)

Relevant OFRs	Listed high concern chemicals: <u>Polyhalogenated benzene aliphatics and functionalized</u> • Pentabromoethylbenzene (85-22-3) • benzene, pentabromomethyl- (87-83-2) • benzene, pentabromo(bromomethyl)- (38521-51-6) • 2-propenoic acid, (pentabromophenyl)methyl ester (59447-55-1) • Decabromodiphenyl ethane (DBDPE) (84852-53-9) <u>Polyhalogenated benzenes</u> • benzene, hexabromo- (87-82-1) • Benzene, 1,3,5-tribromo- (626-39-1) • 1,1'-biphenyl, 2,2',3,3',4,4',5,5',6,6'-decabromo- (13654-09-6) • Octabromobiphenyl (27858-07-7) • 1,1'-biphenyl, hexabromo- (36355-01-8) • Hexabromobiphenyl (59536-65-1) <u>Polyhalogenated aliphatic chains</u> • 2,3-Dibromo-1-propanol (96-13-9) • 2,2-Bis(bromomethyl)-1,3-propanediol (3296-90-0) • Alkanes, chloro (61788-76-9) • paraffin waxes and hydrocarbon waxes, chlorinated (63449-39-8) • Alkanes, C6-18, chloro (68920-70-7) • Alkanes, C10-21, chloro (84082-38-2) • Paraffin oils, chloro (85422-92-0) • Short-chain chlorinated paraffins (85535-84-8) • alkanes, C14-17, chloro (85535-85-9) • Alkanes, C18-28, chloro (85535-86-0) • Alkanes, C18-20, chloro (106232-85-3) • Chlorinated paraffins (Average chain length, C12; approximately 60 percent chlorine by weight) (108171-26-2) <u>Polyhalogenated diphenyl ethers</u> • 4-Bromophenyl phenyl ether (101-55-3) • Decabromodiphenyl ether [Polybrominated diphenyl ethers] (1163-19-5) • PBDE-047 [2,2',4,4'-Tetrabromodiphenyl ether] (5436-43-1) • Pentabromodiphenyl ether [Polybrominated diphenyl ethers] (32534-81-9) • Octabromodiphenyl ether [Polybrominated diphenyl ethers] (32536-52-0) • 2,4,6-bromophenyl 1-2(2,3-dibromo-2-methylpropyl) (36065-30-2) • Benzene, 1,1'-oxybis-, hexabromo deriv. (36483-60-0) • Benzene, 1,1'-oxybis-, tetrabromo deriv. (40088-47-9) • PBDE-099 [2,2’,4,4’,5-Pentabromodiphenyl ether] (60348-60-9) • PBDE-153 [2,2',4,4',5,5'-hexabromodiphenyl ether] (68631-49-2) • PBDE-100 [2,2’,4,4’,6-Pentabromodiphenyl ether] (189084-64-8)

Relevant OFRs	Listed high concern chemicals: Polyhalogenated carbocycles • 4,7-methanoisobenzofuran-1,3-dione, 4,5,6,7,8,8-hexachloro-3a,4,7,7a-tetrahydro (115-27-5) • Chlorendic acid (115-28-6) • Octachloronaphthalene (2234-13-1) • Mirex (2385-85-5) • Dechlorane plus (13560-89-9) Polyhalogenated organophosphates • Tris(2-chloroethyl) phosphate (115-96-8) • Tris(2,3-dibromopropyl) phosphate (tris) (126-72-7) • Tris (1-chloro-2-propyl) phosphate (TCPP) (13674-84-5) • Tris(1,3-dichloro-2-propyl) phosphate (13674-87-8) • Bis (chloromethyl) propane-1,3-diyl tetrakis-(2-chloroethyl) bis(phosphate)(V6) (38051-10-4) Polyhalogenated phenol derivatives • 2,4,6-tribromophenol (118-79-6) • phenol, pentabromo- (608-71-9) Polyhalogenated phthalates/benzoates/imides • 1,3-isobenzofurandione, 4,5,6,7-tetrabromo- (632-79-1) • Bis (2-ethylhexyl) tetrabromophthalate (TBPH) (26040-51-7) • 2-ethylhexyl-2,3,4,5-tetrabromobenzoate (TBB) (183658-27-7) Polyhalogenated phenol-aliphatic ether • benzene, 1,3,5-tribromo-2-(2-propenyloxy)- (3278-89-5) Polyhalogenated triazines • 1,3,5-triazine-2,4,6(1H,3H,5H)-trione, 1,3,5-tris(2,3-dibromopropyl)- (52434-90-9) Listed priority chemicals: Polyhalogenated diphenyl ethers • Decabromodiphenyl ether (decaBDE) (1163-19-5) Polyhalogenated alicycles • Hexabromocyclododecane (HBCD) (3194-55-6)
Implementing Agency	Minnesota Department of Health
Link to text	https://www.revisor.mn.gov/bills/text.php?number=HF2123&type=bill&version=4&session=ls86&session_year=2009&session_number=0: HF 2123 https://www.revisor.mn.gov/statutes/cite/116.9401#stat.116.9401: Minn. Stat. 2010 116.9401 – 116.9407

Additional information:	https://www.health.state.mn.us/communities/environment/childenvhealth/docs/chlist/mdhchc2019.pdf : List of Chemicals of High Concern https://www.health.state.mn.us/communities/environment/childenvhealth/tfka/priority.html#chemicals : List of Priority Chemicals https://www.health.state.mn.us/communities/environment/childenvhealth/tfka/index.html : More information on the act

Name	Firefighter and Children Health Protection Act: A bill for an act relating to health; prohibiting the use of certain flame-retardant chemicals in certain products; requiring a report; proposing coding for new law in Minnesota Statutes, chapter 325F.
Citation	SF 1215
Status	Existing law
Date	Effective October 1, 2015
Description	Prohibits manufacturers or wholesalers from manufacturing, selling, or distributing children's products and upholstered residential furniture containing TDCPP, decaBDE, HBCD, or TCEP in amounts greater than 1,000 ppm, effective July 1, 2018 • Does not apply to used products Prohibits retailers from selling children's products or upholstered residential furniture containing TDCPP, decaBDE, HBCD, or TCEP in amounts greater than 1,000 ppm, effective July 1, 2019 Prohibits manufacturers from replacing TDCPP, decaBDE, HBCD, or TCEP with a chemical known or suspected to… • harm the normal development of a fetus or child or cause other developmental toxicity; • cause cancer, genetic damage, or reproductive harm; • disrupt the endocrine or hormone system; or • damage the nervous system, immune system, or organs, or cause other systemic toxicity Requires the MDH, in consultation with the State Fire Marshal, to develop a report on the status of flame retardants by January 15, 2016
Category	• Restricts use of OFRs • Requires additional research of OFRs
Relevant Products	• Children's products • Residential upholstered furniture
Relevant OFRs	<u>Polyhalogenated organophosphates</u> • TDCPP (tris(1,3-dichloro-2-propyl) phosphate) (13674-87-8) • TCEP (tris(2-chloroethyl) phosphate) (115-96-8) <u>Polyhalogenated diphenyl ethers</u> • Decabromodiphenyl ether (1163-19-5) <u>Polyhalogenated alicycles</u> • Hexabromocyclododecane (25637-99-4)
Implementing Agency	Minnesota Department of Health (MDH)
Link to text	https://www.revisor.mn.gov/bills/text.php?number=SF1215&version=latest&session=ls89&session_year=2015&session_number=0
Additional information:	https://www.health.state.mn.us/communities/environment/risk/docs/studies/retardantreport.pdf : report developed by MDH and State Fire Marshal

Name	A bill for an act relating to health; prohibiting the use of certain flame-retardant chemicals in certain products; allowing certain exemptions; amending Minnesota Statutes 2018, section 325F.071; proposing coding for new law in Minnesota Statutes, chapter 325F.
Citation	HF 359
Status	Existing law
Date	Enacted May 22, 2019, ban effective July 1, 2021
Description	Prohibits manufacturers and wholesalers from manufacturing, selling, and distributing children's products, upholstered residential furniture, residential textile, or mattress containing any organohalogenated flame retardant in amounts greater than 1,000 ppm, effective July 1, 2021 Prohibits retailers from selling children's products, upholstered residential furniture, residential textile, or mattress containing any organohalogenated flame retardant in amounts greater than 1,000 ppm, effective July 1, 2022 Does not apply to the following products: • Previously owned products • Electronic components of children's products, mattresses, upholstered residential furniture, or residential textiles and associated casings • Children's products, mattresses, upholstered residential furniture, or residential textiles for which there are federal or national flammability standards • Thread or fiber used for stitching mattress components together • Components of an adult mattress other than foam Does not apply to a flame retardants that: • Is a polymeric material or is chemically reacted to form a polymeric material with the material it is intended to protect • Has a determination of safety under United States Code, title 15, section 2604, subsection (a), paragraph (3), subparagraph (C), or under United States Code, title 15, section 2605, subsection (b), paragraph (4). Restricts manufacturers from replacing a restricted organohalogenated flame retardant with a chemical known or suspected to be… • Harm the normal development of a fetus or child or cause other developmental toxicity • Cause cancer, genetic damage, or reproductive harm • Disrupt the endocrine or hormone system • Damage the nervous system, immune system, organs, or cause other systemic toxicity
Category	Restricts the use of OFRs
Relevant Products	• Children's products • Upholstered residential furniture • Residential textiles • Mattresses
Relevant OFRs	All OFRs (with some exceptions, listed in the description)
Implementing Agency	Minnesota Pollution Control Agency, in coordination with the commissioners of commerce and health

Link to text	http://wdoc.house.leg.state.mn.us/leg/LS91/HF0359.2.pdf
Additional information:	"Organohalogenated chemical" is defined as "any chemical that contains one or more carbon elements and one or more halogen elements, including fluorine, chlorine, bromine, or iodine."

R.13 LEGAL TRENDS FACT SHEET: STATE OF NEVADA

Relevant Law or Regulations:

Name	An act relating to toxic chemicals; prohibiting, with certain exceptions, the discharge, use or release of certain Class B firefighting foams; requiring, with certain exceptions, certain entities who discharge, use or release certain Class B firefighting foam to notify the Division of Environmental Protection of the State Department of Conservation and Natural Resources; requiring the Division to establish a working group to study issues relating to certain substances; prohibiting, with certain exceptions, the manufacture, sale or distribution of certain products containing certain chemicals; providing penalties; and providing other matters properly relating thereto.
Citation	AB 97
Status	Existing law
Date	Effective May 27, 2021
Description	Prohibits manufacturers, wholesalers, and retailers from manufacturing, distributing, and selling children's products, upholstered residential furniture, residential and business textiles, and mattresses containing any flame-retardant organohalogenated chemical in amounts greater than 1,000 parts per million. • Prohibits the manufacturer from replacing such flame retardants with other chemicals suspected to cause harm. Does not apply to: • Any flame retardant that is a polymeric substance or is chemically reacted to form a polymer with the materials it is intended to protect • Has a determination of safety pursuant to 15 U.S.C. § 2604(a)(3)(C) 43 or 15 U.S.C. § 2605(b)(4) • The sale of any previously owned product • An electronic component of a children's product, mattress, upholstered residential furniture or residential textile or any associated casing • A children's product, mattress, upholstered residential furniture or residential textile for which there is a federal or national flammability standard • Thread or fiber for stitching mattress components together • Or components of an adult mattress other than foam.
Category	Restricts use of OFRs
Relevant Products	• Children's products • Upholstered residential furniture • Residential textiles • Business textiles • Mattresses
Relevant OFRs	All OFRs
Implementing Agency	Division of Environmental Protection of the State Department of Conservation and Natural Resources
Link to text	https://www.leg.state.nv.us/Session/81st2021/Bills/AB/AB97_EN.pdf

Additional information:	Organohalogenated chemicals are defined as "any chemical that contains one or more carbon elements and one or more halogen elements, including, without limitation, fluorine, chlorine, bromide or iodine."

R.14 LEGAL TRENDS FACT SHEET: STATE OF NEW HAMPSHIRE

Relevant Law or Regulations:

Name	Sale of Furniture with Flame Retardant Chemicals: An Act prohibiting the sale of certain furniture and carpeting with flame retardant chemicals.
Citation	SB 193-FN
Status	Existing law
Date	Effective September 3, 2019

Description	Prohibits the manufacturing and sale of upholstered furniture containing more than 0.1% of a flame retardant chemical or mixture that includes flame retardant chemicals.
	• Does not apply to:
	  ○ Used or antique upholstered furniture
	  ○ Upholstered furniture purchased for public use in public facilities
	  ○ New upholstered furniture imported into the state or acquired by the retailer prior to January 1, 2021
	  ○ New upholstered furniture manufactured prior to January 1, 2020
	  ○ Upholstered furniture which includes electronic or electronic components
	  ○ Mattresses

Category	Restricts use of OFRs
Relevant Products	Upholstered furniture
Relevant OFRs	All OFRs
Implementing Agency	• New Hampshire Department of Justice • New Hampshire Department of Safety
Link to text	http://www.gencourt.state.nh.us/legislation/2019/SB0193.html
Additional information:	Products that meet the following requirements shall be deemed in compliance: • Upholstered furniture bearing a label or accompanied by a certificate indicating compliance with California BPC section 19101, as amended. • Upholstered furniture bearing a label, as prescribed by California BPC section 19094 (2014), indicating that the product's upholstery materials "contain NO added flame retardant chemicals."

R.15 LEGAL TRENDS FACT SHEET: STATE OF NEW JERSEY

Relevant Law or Regulations:

Name	An act concerning certain chemicals in children's products and supplementing P.L. 1960, c.39 (C. 56:8-1 et seq.).
Citation	A 2104/ S 1203
Status	Pending legislation
Date	Introduced January 14, 2020, effective January 1, 3 years following the date of enactment
Description	Would require the Dept. of Environmental Protection to post a list of dangerous chemicals and a list of 20 chemicals of concern on their website, within 180 days of the law's enactment. • These chemicals must be periodically reviewed Would require manufacturers of children's products to report use of dangerous chemicals or chemicals of concern to the Dept. of Environmental Protection, within 12 months of the chemicals being added to the Department's list of dangerous chemicals. Would prohibit the sale and distribution of children's products containing tris (1, 3 dichloro-2-propyl) phosphate, benzene, formaldehyde (other than in textiles), asbestos, or organohalogen flame retardants. • Does not apply to: o Children's products solely based on it containing an enclosed battery or enclosed electronic components o Any children's products where state regulation is preempted by federal law o Any children's products where the chemical is present as a trace contaminant Would prohibit the sale of any children's product that contains a chemical on the dangerous chemicals list. Would prohibit the sale of children's products containing dangerous chemicals unless the manufacturer has provided a notification.
Category	• Identifies OFRs as hazardous chemicals • Restricts use of OFRs • Requires reporting or data sharing
Relevant Products	Children's products

Relevant OFRs	Polyhalogenated alicycles • Hexabromocyclododecane (HBCD) (25637-99-4) Polyhalogenated aliphatic chains • Short chain chlorinated paraffins (SCCP) (85535-84-8) • Chlorinated paraffins (108171-26-2) Polyhalogenated benzene aliphatics and functionalized • Decabromodiphenyl ethane (DBPE) (84852-53-9) Polyhalogenated bisphenol aliphatics and functionalized • Tetrabromobisphenol A (79-94-7) Polyhalogenated diphenyl ethers (PBDEs) • DecaBDE (BDE-209) (1163-19-5) Polyhalogenated organophosphates (PFRs) • Tris (2, 3-dibromopropylphosphate) (126-72-7) • Tris(2-chloroethyl) phosphate (115-96-8) • Tris (1-chloro-2-propyl) phosphate (TCPP) (13674-84-5) • Tris (1, 3 dichloro-2-propyl) phosphate (13674-87-8) • Bis(chloromethyl) propane-1-3-diyltetrakis-(2-chloroethyl) bis(phosphate)(V6)(38051-10-4) Polyhalogenated phthalates/benzoates/imides • 2-Ethyl-hexyl-2, 3, 4, 5 tetrabromobenzoate (TBB) (183658-27-7) • Bis(2-ethylhexyl) tetrabromophtalate (TBPH) (26040-51-7)
Implementing Agency	New Jersey Department of Environmental Protection
Link to text	https://legiscan.com/NJ/text/A2104/id/2095141
Additional information:	The act defines "Chemical of concern" and "Dangerous chemical." The act defines "Children's product" as a product sold or distributed as new and primarily intended for, made for, or marketed for use by children, such as baby products, toys, car seats, school supplies, personal care products, a product designed or intended by the manufacturer to help a child with sucking or teething, to facilitate sleep, relaxation, or the feeding of a child, and children's novelty products, children's jewelry, children's bedding, furniture, furnishings, and apparel.

R.16 LEGAL TRENDS FACT SHEET: STATE OF NEW YORK

Relevant Law or Regulations:

Name	An act to amend the environmental conservation law, in relation to restricting the use of certain flame retardants and relating to the creation of a state task force on flame retardant safety
Citation	S 7621
Status	Existing law
Date	Enacted August 17, 2004, ban effective January 1, 2006

Description	Prohibits manufacturing, processing, or distributing products or flame-retardant parts of products containing more than one tenth of one percent of pentabrominated diphenyl ether or octabrominated diphenyl ether, by mass
	• Does not apply to:
	  ○ Common carriers shipping or delivering products through the state for commerce in another jurisdiction
	  ○ Resale of products manufactured prior to January 1, 2006
	  ○ Processing of metallic recyclables
	
	Creates a state task force on flame retardant safety, which must develop a report on decaBDE and its alternatives by December 31, 2005.

Category	• Restricts use of OFRs • Requires additional research of OFRs
Relevant Products	All/ any products or flame-retarded parts of products
Relevant OFRs	Polyhalogenated diphenyl ethers • Pentabrominated diphenyl ether • Octabrominated diphenyl ether • Decabrominated diphenyl ether
Implementing Agency	• New York State Department of Environmental Conservation • New York State Department of Health
Link to text	https://assembly.state.ny.us/leg/?default_fld=&bn=S07621&term=2003&Summary=Y&Text=Y
Additional information:	https://www.health.ny.gov/environmental/investigations/flame/docs/report.pdf

Name	TRIS-Free Children and Babies Act: An act to amend the environmental conservation law, in relation to prohibiting the sale of child products containing TRIS
Citation	A 6195
Status	Existing law
Date	Effective August 1, 2011
Description	Prohibits selling child care products intended for use by children three years old or younger containing tris. • Does not apply to: ○ The sale or distribution of child care products resold or distributed by consumers for consumer use
Category	Restricts use of OFRs
Relevant Products	Children's products
Relevant OFRs	Polyhalogenated organophosphates • Tris (2-chloroethyl) phosphate (TCEP)
Implementing Agency	New York State Department of Environmental Conservation
Link to text	https://assembly.state.ny.us/leg/?default_fld=&bn=A06195&term=2011&Summary=Y&Text=Y
Additional information:	A child care product is defined as "a consumer product intended for use by children under three years of age, such as baby products, toys, car seats, nursing pillows, crib mattresses, and strollers"

Name	An act to amend the environmental conservation law, in relation to expanding the TRIS-free children and babies act
Citation	SB 3703/ A 4741
Status	Existing law
Date	Enacted September 18, 2014, effective December 1, 2015
Description	Expands the Tris-free Children and Babies Act to include TDCPP.
Category	Restricts use of OFRs
Relevant Products	Children's products
Relevant OFRs	Polyhalogenated organophosphates • Tris (1,3-dichloro-2-propyl) phosphate (TDCPP)
Implementing Agency	New York State Department of Environmental Conservation
Link to text	https://assembly.state.ny.us/leg/?default_fld=&leg_video=&bn=S03703&term=2013&Summary=Y&Actions=Y&Text=Y
Additional information:	

Name	An act to amend the environmental conservation law, in relation to regulation of toxic chemicals in children's products
Citation	A 6296
Status	Existing law
Date	Effective March 1, 2020

Description	• Requires the Department of Environmental Conservation to post lists of dangerous chemicals and chemicals of concern on their website within 180 days of the effective date of this title
	  ○ The department, in consultation with the Department of Health, must periodically review this list
	• Requires manufacturers of children's products containing dangerous chemicals or chemicals of concern to report such chemical use, no later than 12 months after a dangerous chemical appears on the list
	  ○ This report must identify the children's product, the dangerous chemical or chemicals of concern contained in the children's product and the intended purpose of such chemicals
	  ○ The department may also require reporting of
	  ▪ the amount of such chemical in the children's product; or
	  ▪ information on the likelihood that the chemical will be released from the children's product to the environment during the product's life cycle and the extent to which users of the product are likely to be exposed to the chemical
	  ○ Authorizes the department to submit reports to the interstate chemicals clearinghouse
	• Prohibits distributing and selling children's products containing tris (1, 3 dichloro-2-propyl) phosphate, benzene, formaldehyde (other than in textiles), asbestos, and organohalogen flame retardants, effective January 1, 2023
	  ○ Does not apply to:
	  ▪ A children's product solely based on its containing an enclosed battery or enclosed electronic components
	  ▪ Where state regulation of children's products is preempted by federal law
	• Prohibits distributing and selling children's products containing a chemical on the dangerous chemicals list, effective three years after being added to the dangerous chemicals list
	  ○ Does not apply to:
	  ▪ A children's product solely based on its containing an enclosed battery or enclosed electronic components
	  ▪ Where state regulation of children's products is preempted by federal law
	• Does not apply to:
	  ○ Used children's products sold or distributed for free at secondhand stores, yard sales on the internet, or donated to charities
	  ○ Priority chemicals used in or for industry or manufacturing, including chemicals processed or otherwise used in or for industrial or manufacturing processes and not included in the final report
	  ○ Motor vehicles, watercraft, all terrain vehicles, or off-highway motorcycles and their component parts
	  ○ Dangerous chemicals generated solely as combustion by-products or present in combustible fuels
	  ○ Children's product makers that employ five persons or fewer, and are independently owned and operated

Category	• Restricts use of OFRs • Requires reporting or data sharing
Relevant Products	Children's products
Relevant OFRs	All OFRs
Implementing Agency	New York State Department of Environmental Conservation
Link to text	https://legislation.nysenate.gov/pdf/bills/2019/A6296A
Additional information:	https://www.dec.ny.gov/chemical/122890.html#:~:text=ECL%20Article%2037%20instructs%20DEC%20to%20promulgate%20lists,or%20tris%20%281%2C3-dichloro-2-propyl%29%20phosphate%20effective%20January%201%2C%202023. : In the process of developing a rule to implement portions of the law

Name	Family and Fire Fighter Protection Act: An act to amend the environmental conservation law, in relation to the regulation of chemicals in upholstered furniture, mattresses and electronic enclosures
Citation	S 4630/ A5418
Status	Existing law
Date	Effective December 31, 2021

Description	• Prohibits the sale of new upholstered furniture or mattresses that contains any intentionally added covered flame retardants, beginning January 1, 2024
	• Prohibits custom upholsterers from repairing or restoring upholstered furniture using replacement components that contain any intentionally added covered flame retardants, beginning January 1, 2023
	• Does not apply to:
	  ○ Electronic components of mattresses, reupholstered furniture, or upholstered furniture, or any associated casing for such electronic components
	  ○ Upholstered or reupholstered furniture components other than those identified in this bill
	  ○ Thread or fiber used to stitch mattress components together
	  ○ The natural fibers wool, silk, and other animal fibers
	  ○ Textiles made using modacrylic fiber components without antimony trioxide when used internally as a barrier material in a memory foam or gel foam mattress or aramid fibers when used in the fabric that covers the bottom (non-sleep surface) of a mattress that has a sleeping surface on only one side of the mattress. This exemption would expire on January 1, 2026
	• Prohibits the sale of electronic displays that contain intentionally added organohalogen flame retardants in the enclosure or stand, beginning January 1, 2024
	• Requires manufacturers to submit an annual report identifying all flame retardants used in the enclosure or stand of the electronic display, one year after the effective date of this title

Category	• Restricts use of OFRs • Requires reporting or data sharing
Relevant Products	• Upholstered furniture • Mattresses • Electronic displays
Relevant OFRs	All OFRs
Implementing Agency	New York State Department of Environmental Conservation
Link to text	https://legislation.nysenate.gov/pdf/bills/2021/S4630B
Additional information:	

Name	An act to amend the environmental conservation law, in relation to prohibiting the use of chemical flame retardants
Citation	A 3031/ S 06238
Status	Pending legislation
Date	Introduced January 22, 2021 & April 16, 2021
Description	Would prohibit selling residential upholstered furniture containing chemical flame retardants, effective July 1, 2022 • Does not apply to: ○ Sale or distribution of residential upholstered furniture resold or offered for resale, or distributed by consumers for consumer use
Category	Restricts use of OFRs
Relevant Products	Residential upholstered furniture
Relevant OFRs	All OFRs
Implementing Agency	New York State Department of Environmental Conservation
Link to text	https://nyassembly.gov/leg/?default_fld=&leg_video=&bn=A03031&term=2021&Summary=Y&Text=Y https://legislation.nysenate.gov/pdf/bills/2021/S6238
Additional information:	"Chemical flame retardants" shall mean any halogenated chemical flame retardant, including but not limited to TDCPP Tris (1, 3- Dicholoro-2-propyl) phosphate, and any Phosphorus-Bromine flame retardants.

R.17 LEGAL TRENDS FACT SHEET: STATE OF OREGON

Relevant Law or Regulations:

Name	Relating to brominated flame retardants; creating new provisions; and amending ORS 453.005, 453.085 and 453.995.
Citation	SB 962
Status	Existing law
Date	Enacted 2005

Description	Prohibits the commerce of any product containing more than one tenth of one percent by mass of pentaBDE or octaBDE.
	• Does not apply to:
	  ○ Used products
	  ○ Replacement parts introduced into commerce before the effective date of this act
	
	Requires a report on PBDEs every other year, that reviews new studies on decaBDE and recommendations regarding the disposal of products containing PBDEs.

Category	• Restricts use of OFRs • Requires additional research of OFRs
Relevant Products	All/ any products
Relevant OFRs	Polyhalogenated diphenyl ethers • Pentabrominated diphenyl ether (pentaBDE) • Octabrominated diphenyl ether (octaBDE)
Implementing Agency	Department of Human Services
Link to text	https://www.oregonlegislature.gov/bills_laws/archivebills/2005_sb0962.en.pdf
Additional information:	

Name	Relating to decabrominated diphenyl ether; creating new provisions; and amending ORS 453.005, 453.025 and 453.085.
Citation	SB 596
Status	Existing law
Date	Adopted in 2010, ban effective January 1, 2011

Description	Prohibits the commerce of any product containing more than one tenth of one percent by mass of decabrominated diphenyl ether, beginning January 1, 2011
	• Does not apply to:
	  ○ Used products
	  ○ Replacement parts introduced into commerce before January 1, 2011

Category	Restricts use of OFRs
Relevant Products	All/ any products
Relevant OFRs	Polyhalogenated diphenyl ethers • Decabrominated diphenyl ether (decaBDE)
Implementing Agency	The Director of Human Services (Department of Human Services)
Link to text	https://olis.oregonlegislature.gov/liz/2009R1/Downloads/MeasureDocument/SB596
Additional information:	

Name	Toxic Free Kids Act
Citation	SB 478/ HB 3473
Status	Existing law
Date	Enacted 2015, operative January 1, 2016
Description	• Requires the Oregon Health Authority (OHA) to establish and maintain a list of High Priority Chemicals of Concern for Children's Health (HPCCCH) when used in children's products, which shall include chemicals listed on Washington State Dept. of Ecology's Reporting List of Chemicals of High Concern to Children • Requires manufacturers of children's products that contain a chemical on the HPCCCH in an amount at or above de minimus level to provide a biennial notice to OHA by January 1 of each applicable notice year, starting in 2018 ○ The manufacturer must remove or make a substitution for the chemical, or seek a waiver, by the third biennial notice • The Oregon Health Authority's Toxic-Free Kids program will gather information from manufacturers that use these chemicals in their children's products to help fill a data gap that exists for both consumers and agencies. • Authorizes OHA to participate in the Interstate Chemicals Clearinghouse in cooperation with other states and government entities to assist the authority in carrying out ORS 431A.253 to 431A.280 • Requires OHA to report on revisions made to the HPCCCH, the number of manufacturers of children's products in compliance with this act, and a
Category	• Identifies OFRs as hazardous chemicals • Restricts use of OFRs • Requires reporting or data sharing
Relevant Product	Children's products
Relevant OFRs	Listed High Priority Chemicals of Concern for Children's Health <u>Polyhalogenated diphenyl ethers</u> • 2,2',3,3',4,4',5,5',6,6'-Decabromodiphenyl ether; BDE-209 (1163-19-5) <u>Polyhalogenated phthalates/benzoates/imides</u> • 2-Ethylhexyl-2,3,4,5-tetrabromobenzoate (TBB) (183658-27-7) <u>Polyhalogenated aliphatic chains</u> • Short-chain chlorinated paraffins (SCCP) (85535-84-8) <u>Polyhalogenated bisphenol aliphatics and functionalized</u> • Tetrabromobisphenol A (79-94-7) <u>Polyhalogenated organophosphates</u> • Tris(1,3-dichloro-2-propyl) phosphate (13674-87-8) • Tris (1-chloro-2-propyl) phosphate (TCPP) (13674-84-5) • Tris(2-chloroethyl) phosphate (115-96-8) <u>Polyhalogenated alicycles</u> • Hexabromocyclododecane (25637-99-4)

Implementing Agency	Oregon Health Authority (OHA)
Link to text	https://olis.oregonlegislature.gov/liz/2015R1/Downloads/MeasureDocument/SB478/B-Engrossed https://www.oregonlegislature.gov/bills_laws/ors/ors431a.html
Additional information:	https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/HEALTHYNEIGHBORHOODS/TOXICSUBSTANCES/Pages/Toxic-Free-Rules.aspx : More information on the act and its implementation https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/HEALTHYNEIGHBORHOODS/TOXICSUBSTANCES/Pages/childrens-chemicals-of-concern.aspx : Current list of High Priority Chemicals of Concern for Children's Health

R.18 LEGAL TRENDS FACT SHEET: STATE OF RHODE ISLAND

Relevant Law or Regulations:

Name	Hazardous Chemicals -- Contamination Of Breast Milk And Environment: An Act relating to health and safety
Citation	HB 7917
Status	Existing law
Date	Enacted July 12, 2006, ban effective January 1, 2007

Description	Prohibits manufacturing, processing, or distributing products or flame-retardant parts of products containing more than one tenth of one percent of pentaBDE or octaBDE.
	• Does not apply to:
	  ○ Used products
	  ○ Distribution of replacement service parts manufactured before the effective date of this act
	  ○ The processing of recycled materials containing pentaBDE or octaBDE
	  ○ Products containing small quantities of PBDEs that are used for scientific research on the health or environmental effects of PBDEs
	
	Requires a study on decaBDE by January 2nd, 2007

Category	• Restricts use of OFRs • Requires additional research of OFRs
Relevant Products	All/any products or flame-retarded parts of products
Relevant OFRs	Polyhalogenated diphenyl ethers • Decabromodiphenyl ether (DecaBDE) (studied, but not prohibited) • Octabromodiphenyl ether (OctaBDE) • Pentabromodiphenyl ether (PentaBDE)
Implementing Agency	The Rhode Island Department of Environmental Management will develop the decaBDE study The Rhode Island Department of Health will review the decaBDE study
Link to text	http://webserver.rilin.state.ri.us/billtext06/housetext06/h7917a.pdf
Additional information:	Nothing in this act restricts the transportation of products containing PBDEs through the state or storing PBDEs in the state for distribution elsewhere

Name	An Act Relating the Health and Safety – Child Products and Upholstered Furniture
Citation	H 50852
Status	Existing law
Date	Enacted October 3, 2017, ban effective July 1, 2019
Description	Prohibits manufacturing, selling, or distributing residential upholstered bedding or furniture containing 100 ppm or greater of any organohalogen flame retardant. • Exceptions: products sold or in use prior to January 1, 2020 Manufacturers of products that are banned must notify sellers of this ban within 90 days of the effective date.
Category	Restricts use of OFRs
Relevant Products	Residential upholstered bedding and furniture
Relevant OFRs	All OFRs
Implementing Agency	Rhode Island Department of Health
Link to text	http://webserver.rilin.state.ri.us/PublicLaws/law17/law17381.htm
Additional information:	Organohalogen flame retardant chemicals are defined as "any chemical containing the element bromine or chlorine bonded to carbon that is added to a plastic, foam, or textile."

R.19 LEGAL TRENDS FACT SHEET: STATE OF VERMONT

Relevant Law or Regulations:

Name	Implementing Health Care Provisions of the American Recovery and Reinvestment Act: An act relating to health care reform.
Citation	H444 / S109
Status	Existing law
Date	Effective July 1, 2009

Description	• Prohibits the sale and distribution of products containing octaBDE or pentaBDE in a concentration greater than 0.1 percent by weight, as of July 1, 2010.
	• Prohibits the sale, distribution, and manufacture of a mattress, mattress pad, or upholstered furniture containing decaBDE in a concentration greater than 0.1 percent by weight, as of July 1, 2010.
	  ○ Does not apply to:
	  ▪ Inventory purchased prior to July 1, 2009
	• Prohibits the sale, distribution, and manufacture of televisions and computers with a plastic housing containing decaBDE in a concentration greater than 0.1 percent by weight, as of July 1, 2012.
	  ○ Does not apply to:
	  ▪ Inventory purchased prior to July 1, 2009
	• Manufacturers of products containing decaBDE, that are prohibited under this article, must notify sellers of the requirements of this article.
	• Prohibits manufacturers from replacing decaBDE with a known or suspected carcinogen, or a chemical identified by the USEPA as causing birth defects, hormone disruption, or harm to reproduction or development, as of July 1, 2010
	• Authorizes the attorney general to request a manufacturer to provide a certificate of compliance
	  ○ Within 30 days of the request, the manufacturer is required to…
	  ▪ Provide a certificate declaring that its products comply with the requirements of this section; or
	  ▪ Notify persons who sell the product of the manufacturer's which does not comply with this section that sale of the product is prohibited and submit to the attorney general a list of the names and addresses of those notified
	
	This bill covers a large range of topics. This description only focuses on Chapter 80, which is relevant to flame retardants

Category	• Restricts use of OFRs • Requires reporting or data sharing
Relevant Products	• Mattresses • Mattress pads • Upholstered furniture • Televisions • Computers

Relevant OFRs	Polyhalogenated diphenyl ethers • Decabromodiphenyl ether (DecaBDE) • Octabromodiphenyl ether (OctaBDE) • Pentabromodiphenyl ether (PentaBDE)
Implementing Agency	Office of the Vermont Attorney General
Link to text	https://legislature.vermont.gov/Documents/2010/Docs/ACTS/ACT061/ACT061%20As%20Enacted.pdf
Additional information:	**Amended by S81**

Name	An act relating to the regulation of octaBDE, pentaBDE, decaBDE, and the flame retardant known as Tris in consumer products
Citation	S81
Status	Existing law
Date	Effective July 1, 2013

Description	• Prohibits the sale and distribution of products containing octaBDE or pentaBDE in a concentration greater than 0.1 percent by weight, as of July 1, 2010
	• Prohibits the manufacture, sale, and distribution of mattresses, mattress pads, and upholstered furniture containing decaBDE in a concentration greater than 0.1 percent by weight, as of July 1, 2010
	  ○ Does not apply to:
	  ▪ Inventory purchased prior to July 1, 2009
	• Prohibits the manufacture, sale, and distribution of televisions or computers with a plastic housing containing decaBDE in a concentration greater than 0.1 percent by weight, as of July 1, 2012
	  ○ Does not apply to:
	  ▪ Inventory purchased prior to July 1, 2009
	• Prohibits the manufacture, sale, and distribution of plastic shipping pallets containing decaBDE in a concentration greater than 0.1 percent by weight, as of July 1, 2013
	  ○ Does not apply to:
	  ▪ Plastic shipping pallets manufactured prior to January 1, 2011
	  ▪ Plastic shipping pallets manufactured from recycled shipping pallets, where the decaBDE concentration is no greater than in the recycled shipping pallet
	• Prohibits any person, other than a retailer, to manufacture distribute, or sell children's products or residential upholstered furniture containing TCEP or TDCPP in a concentration greater than 0.1 percent by weight in any product component, as of January 1, 2014
	  ○ Does not apply to:
	  ▪ Inventory manufactured prior to January 1, 2014
	• Prohibits retailers from selling children's products or residential upholstered furniture containing TCEP or TDCPP in a concentration greater than 0.1 percent by weight in any product component, as of July 1, 2014
	  ○ Does not apply to:
	  ▪ The 0.1% by weight threshold will be applied to the entire article and not to individual product components for the following products:
	  • Personal computers, audio and video equipment, calculators, wireless telephones, game consoles, handheld devices incorporating a screen that are used to access interactive software and their associated peripherals, and cable and other similar connecting devices; and
	  • Interactive software intended for leisure and entertainment, such as computer games, and their storage media, such as compact discs
	• Prohibits manufacturers from replacing decaBDE with a known or suspected carcinogen, or a chemical identified as causing birth defects, hormone disruption, or harm to reproduction or development

Description	• This law does not apply to:
	  ○ Sale of used products
	  ○ Motor vehicles or parts for use on motor vehicles
	  ○ Building insulation materials
	• Authorizes the attorney general to request a manufacturer to provide a certificate of compliance
	  ○ Within 30 days of the request, the manufacturer is required to…
	  ▪ Provide a certificate declaring that its products comply with the requirements of this section; or
	  ▪ Notify persons who sell the product of the manufacturer's which does not comply with this section that sale of the product is prohibited and submit to the attorney general a list of the names and addresses of those notified
	• Authorizes the commissioner to prohibit TCPP if it is found to pose a significant health risk

Category	• Restricts use of OFRs • Requires reporting or data sharing
Relevant Products	• Children's products • Mattresses • Mattress pads • Upholstered furniture • Plastic shipping pallets
Relevant OFRs	Polyhalogenated diphenyl ethers • Decabromodiphenyl ether (DecaBDE) • Octabromodiphenyl ether (OctaBDE) • Pentabromodiphenyl ether (PentaBDE) Polyhalogenated organophosphates • Tris(2-chloroethyl) phosphate (TCEP) (115-96-8) • Tris(2-chloroisopropyl) phosphate (TCPP) (13674-84-5) • Tris(1,3-dichloro-2-propyl) phosphate (TDCPP) (13674-87-8)
Implementing Agency	Vermont Department of Health Vermont Attorney General
Link to text	https://legislature.vermont.gov/Documents/2014/Docs/ACTS/ACT085/ACT085%20As%20Enacted.pdf
Additional information:	**Restructures and expands on H444/ S109**

Name	An act relating to the regulation of toxic substances
Citation	S.239
Status	Existing law
Date	Effective June 10, 2014

Description	• Establishes a list of chemicals of high concern to children
	• Requires the Commissioner of Health to review the list and recommend at least two chemicals of high concern beginning on July 1, 2017, and biennially thereafter
	• Establishes a Chemicals of High Concern to Children Working Group within the Department of Health
	• Beginning on July 1, 2016, and biennially thereafter, a manufacturer of a children's product must submit to the Department a notice if a chemical of high concern to children is:
	  o intentionally added to a children's product at a level above the PQL produced by the manufacturer; or
	  o present in a children's product produced by the manufacturer as a contaminant at a concentration of 100 parts per million or greater
	• The notice must contain the following information:
	  o the name of the chemical used or produced and its chemical abstracts service registry number
	  o a description of the product or product component containing the chemical
	  o the amount of the chemical contained in each unit of the product or product component, reported by weight or parts per million as authorized by the Commissioner
	  o the name and address of the manufacturer of the children's product and the name, address, and telephone number of a contact person for the manufacturer
	• Authorizes the department to enter into reciprocal data-sharing agreements with other states in which a manufacturer of children's products is also required to disclose information related to chemicals of high concern to children in children's products

Category	• Restricts use of OFRs • Requires reporting or data sharing
Relevant Products	Children's products
Relevant OFRs	<u>Polyhalogenated alicycles</u> • Hexabromocyclododecane, HBCD (25637-99-4) <u>Polyhalogenated aliphatic chains</u> • Short-chain chlorinated paraffins (85535-84-8) <u>Polyhalogenated benzene aliphatics and functionalized</u> • Decabromodiphenyl ethane, DBDPE (84852-53-9) <u>Polyhalogenated bisphenol aliphatics and functionalized</u> • Tetrabromobisphenol A, TBBPA (79-94-7) <u>Polyhalogenated diphenyl ethers</u> • 2,2',3,3',4,4',5,5',6,6'-Decabromodiphenyl ether (BDE-209), DecaBDE (1163-19-5)

Relevant OFRs	Polyhalogenated organophosphates • Tris(2-chloroethyl) phosphate, TCEP (115-96-8) • Tris(1,3-dichloro-2-propyl) phosphate, TDCPP (13674-87-8) • Tris(1-chloro-2-propyl) phosphate, TCPP (13674-84-5) • Tris(2,3-dibromopropyl) phosphate, TDBPP (126-72-7) • Bis(chloromethyl)propane-1,3-diyl tetrakis (2-chloroethyl) bis(phosphate) (38051-10-4) Polyhalogenated phthalates/benzoates/imides • 2-ethylhexyl-2,3,4,5-tetrabromobenzoate, TBB (183658-27-7) • Bis(2-ethylhexyl) tetrabromopthalate, TBPH (26040-51-7)
Implementing Agency	Vermont Department of Health, in consultation with the Agency of Natural Resources
Link to text	http://www.leg.state.vt.us/DOCS/2014/ACTS/ACT188.PDF
Additional information:	https://legislature.vermont.gov/statutes/fullchapter/18/038A For more information, visit Vermont's Chemical Disclosure Program for Children's Products website: https://www.healthvermont.gov/environment/children https://www.healthvermont.gov/environment/children/chemicals-childrens-products#:~:text=2019%20Additions%20to%20Vermont%27s%20List%20of%20Chemicals%20of,Tris%20%282%2C3-dibromopropyl%29%20phosphate%20%2016%20more%20rows%20: Chemicals of High Concern to Children list. There are currently 86 chemicals on the State's list of Chemicals of High Concern to Children. Currently, at least 12 of these chemicals are Organohalogen Flame Retardant (OFR) chemicals.

R.20 LEGAL TRENDS FACT SHEET: STATE OF VIRGINIA

Relevant Law or Regulations:

Name	A bill to amend the Code of Virginia by adding in Title 3.2 a subtitle numbered VI, containing a chapter numbered 66, consisting of sections numbered 3.2-6600, 3.2-6601, and 3.2-6602, relating to product safety; flame retardants; civil penalty
Citation	HB 1129
Status	Pending legislation
Date	Introduced January 8, 2020

Description	• Beginning July 1, 2021, this law would prohibit the manufacture, sell, or distribute any product that contains any prohibited flame retardant and is…
	  ○ Intended to be work by or come into close and prolonged contact with a person under 12 years old or a pregnant woman
	  ○ Or is a piece of residential upholstered furniture
	• Manufacturers must notify sellers who sell any prohibited products by March 31, 2021
	• Manufacturers must recall any prohibited products by March 31, 2021
	• Does not apply to:
	  ○ Previously owned products made in a casual sale, isolated sale, or by a nonprofit organization

Category	• Restricts use of OFRs
Relevant Products	• Upholstered furniture • Children's products
Relevant OFRs	Polyhalogenated organophosphates • TDCPP (13674-87-8) • TCEP (115-96-8) • TCPP (13674-84-5) Polyhalogenated bisphenol aliphatics and functionalized • Tetrabromobisphenol A (79-94-7) Polyhalogenated diphenyl ethers • Decabromodiphenyl ether (1163-19-5) Polyhalogenated alicycles • Hexabromocyclododecane (25637-99-4) Polyhalogenated phthalates/benzoates/imides • TBPH (26040-51-7) • TBB (183658-27-7)
Implementing Agency	Virginia Department of Agriculture and Consumer Services
Link to text	https://lis.virginia.gov/cgi-bin/legp604.exe?201+ful+HB1129+pdf
Additional information:	

R.21 LEGAL TRENDS FACT SHEET: STATE OF WASHINGTON

Relevant Law or Regulations:

Name	Persistent Toxic Chemicals
Citation	Executive Order 04-01
Status	Existing law
Date	Effective January 28, 2004
Description	Requires the Department of Ecology, in consultation with the Department of Health, to develop a chemical action plan to reduce threats posed by PBDEs, recommend actions by December 1, 2004, and implement the plan by July 1, 2005
Category	Identifies OFRs as hazardous chemicals
Relevant Products	
Relevant OFRs	Polybrominated diphenyl ethers (PBDEs)
Implementing Agency	Washington Department of Ecology (in consultation with the Department of Health)
Link to text	https://www.digitalarchives.wa.gov/governorlocke/eo/eo_04-01.htm
Additional information:	https://apps.ecology.wa.gov/publications/documents/0507048.pdf: Chemical Action Plan required by this law. Recommends that Washington State should prohibit the manufacture and distribution of pentaBDE and octaBDE. Recommends that decaBDE should be banned if safer alternatives are found.

Name	An Act Relating to phasing out the use of polybrominated diphenyl ethers; adding a new chapter to Title 70 RCW; and prescribing penalties.
Citation	HB 1024
Status	Existing law
Date	Effective July 22, 2007

Description	• Prohibits manufacturing, selling, or distributing noncomestible products containing PBDEs, effective January 1, 2008
	  ○ Does not apply to:
	  ▪ Products containing PBDEs, except as provided in section 4 of this act
	  ▪ Used transportation vehicles manufactured before January 1, 2008
	  ▪ Used or new transportation vehicle parts manufactured before January 1, 2008
	  ▪ Equipment used primarily for military or federally funded space program applications
	  ▪ Federal aviation administration fire worthiness requirements and recommendations
	  ▪ New raw material or component part used in a transportation vehicle containing decaBDE
	  ▪ Commercial decaBDE used in maintenance, refurbishment, or modification of transportation equipment
	  ▪ Any new product or product component consisting of recycled or used materials containing decaBDE
	  ▪ Previously owned products containing PBDEs sold in casual or isolated sales or in sales by nonprofit organizations
	  ▪ New carpet cushion made from recycled foam containing less than one tenth of one percent pentaBDE
	  ▪ Medical devices
	• Prohibits manufacturing, selling, and distributing mattresses containing decaBDE, effective January 1, 2008
	• Requires the Department of Ecology and Department of Health to develop a report on whether safer and technically feasible decaBDE alternatives exist
	• Prohibits manufacturing, selling, and distributing residential upholstered furniture containing decaBDE or any television or computer that has an enclosure that contains decaBDE
	  ○ If the report finds that decaBDE alternatives exist, this prohibition is effective January 1, 2011
	  ○ Otherwise, the prohibition will take place two years after the department reports that a safer alternative is available

Category	• Restricts use of OFRs • Requires additional research of OFRs
Relevant Products	• Noncomestible products • Mattresses
Relevant OFRs	• PBDEs • decaBDE • decaBDE alternatives (studied)
Implementing Agency	Washington Department of Ecology

Link to text	https://lawfilesext.leg.wa.gov/biennium/2007-08/Pdf/Bills/House%20Passed%20Legislature/1024-S.PL.pdf?q=20211122121633
Additional information:	"Comestible" means edible https://apps.ecology.wa.gov/publications/documents/0907041.pdf: Report required by law. Identified safer alternatives that meet applicable fire safety standards

Name	Children's Safe Products Act: An act relating to the children's safe products act; amending RCW 43.70.660; adding a new chapter to Title 70 RCW; creating a new section; and prescribing penalties.
Citation	HB 2647
Status	Existing law
Date	Effective 2008
Description	Prohibits the sale and distribution of children's products containing lead in amounts greater than 90 ppm, cadmium in amounts greater than 40 ppm, or phthalates in amounts greater than 1,000 ppm Requires the department to identify chemicals of high concern for children (CHCC) and children's products that may contain these chemicals by January 1, 2009 Requires the department to submit a report on the chemicals of high to concern to children and the children's products by January 1, 2009 Six months after the department adopts rules to implement this law, manufacturers of children's products containing high priority chemicals must file a notice annually with the following information: • The name of the chemical used or produced and its chemical abstracts service registry number • A brief description of the product or product component containing the substance; (3) A description of the function of the chemical in the product • The amount of the chemical used in each unit of the product or product component. The amount may be reported in ranges, rather than the exact amount • The name and address of the manufacturer and the name, address, and phone number of a contact person for the manufacturer • Any other information the manufacturer deems relevant to the appropriate use of the product
Category	• Restricts use of OFRs • Requires additional research of OFRs • Requires reporting or data sharing
Relevant Products	Children's products
Relevant OFRs	Added to the CHCC by Department of Ecology in 2011: <u>Polyhalogenated bisphenol aliphatics and functionalized</u> • Tetrabromobisphenol A (TBBPA) (79-94-7) <u>Polyhalogenated organophosphates</u> • Tris(2-chloroethyl) phosphate (TCEP) (115-96-8) <u>Polyhalogenated diphenyl ethers</u> • Decabromodiphenyl ether (BDE-209) (1163-19-5) <u>Polyhalogenated alicycles</u> • Hexabromocyclododecane (HBCD) (25637-99-4) Added to the CHCC by Department of Ecology in 2013: <u>Polyhalogenated organophosphates</u> • Tris(1,3-dichloro-2-propyl) phosphate (TDCPP) (13674-87-8)

Implementing Agency	Washington Department of Ecology
Link to text	https://lawfilesext.leg.wa.gov/biennium/2007-08/Pdf/Bills/House%20Passed%20Legislature/2647-S2.PL.pdf?q=20211201102647
Additional information:	*Amended by HB 2545, which adds additional chemicals to the CHCC https://apps.ecology.wa.gov/publications/documents/0907014.pdf : 2009 Children's Safe Product Act Report, required by this act https://apps.leg.wa.gov/WAC/default.aspx?cite=173-334: Ecology adopted the Children's Safe Products Reporting Rule in 2011 https://ecology.wa.gov/Regulations-Pesrmits/Reporting-requirements/Reporting-for-Childrens-Safe-Products-Act/Chemicals-of-high-concern-to-children : CHCC list

Name	Children's Safe Products: An act relating to reducing public health threats that particularly impact highly exposed populations, including children and firefighters, by establishing a process for the department of health to restrict the use of toxic flame retardant chemicals in certain types of consumer products; amending RCW 70.240.010 and 70.240.050; and adding new sections to chapter 70.240 RCW.
Citation	HB 2545
Status	Existing law
Date	Effective June 9, 2016
Description	Prohibits manufacturing, selling, or distributing children's products or residential upholstered furniture containing TDCPP, TCEP, decaBDE, HBCD, or additive TBBPA in amounts greater than 1,000 ppm in any product component, beginning July 1, 2017 • These chemicals are added to the list of chemicals of high concern to children Requires the department to consider whether the following chemicals meet the criteria of a chemical of high concern for children: • IPTPP • TBB • TBPH • TCPP • TPP • V6 If any of these flame retardants are identified as chemicals of high concern for children, the department must create a stakeholder advisory committee for each flame retardant within one year to develop policy options and recommendations to reduce exposure, develop substitutes, and restrict or prohibit the chemical. Does not apply to: • Previously owned products made in casual or isolated sales, or by a nonprofit organization
Category	• Restricts use of OFRs • Requires additional research of OFRs
Relevant Products	• Children's products • Residential upholstered furniture
Relevant OFRs	Added to the CHCC by HB 2545: <u>Polyhalogenated organophosphates</u> • TDCPP (13674-87-8) • TCEP (115-96-8) <u>Polyhalogenated diphenyl ethers</u> • decaBDE (1163-19-5) <u>Polyhalogenated alicycles</u> • HBCD (25637-99-4) <u>Polyhalogenated bisphenol aliphatics and functionalized</u> • Additive TBBPA (79-94-7)

Relevant OFRs	Added to CHCC by the Department of Ecology's 2017 Rule Update Polyhalogenated organophosphates • Tris (2,3-dibromopropyl) phosphate (TDBPP) (126-72-7) • TCPP (13674-84-5) • V6 (38051-10-4) Polyhalogenated phthalates/benzoates/imides • TBB (183658-27-7) • TBPH (26040-51-7) Polyhalogenated benzene aliphatics and functionalized • Decabromodiphenyl ethane (DBDPE) (84852-53-9) Polyhalogenated aliphatic chains • Short-chain chlorinated paraffins (SCCP) (85535-84-8) • Chlorinated paraffins (108171-26-2)
Implementing Agency	Washington Department of Ecology
Link to text	https://lawfilesext.leg.wa.gov/biennium/2015-16/Pdf/Bills/House%20Passed%20Legislature/2545-S.PL.pdf?q=20211122124522
Additional information:	https://apps.ecology.wa.gov/publications/documents/1704021.pdf : Evaluates the six flame retardants and identifies other chemicals for inclusion on the CHCC list

Name	The Pollution Prevention for Healthy People and Puget Sound Act: An Act Relating to preventing toxic pollution that affects public health or the environment; amending RCW 70.240.040, 43.21B.110, and 34.05.272; adding a new chapter to Title 70 RCW; and prescribing penalties
Citation	SB 5135
Status	Existing law
Date	Enacted May 8th, 2019, effective July 28, 2019

Description	• Identifies the following substances as priority chemicals:
	  ○ Phthalates
	  ○ Phenolic compounds
	  ○ Polychlorinated biphenyls (PCBs)
	  ○ Organohalogen flame retardants
	  ○ Per- and polyfluoroalkyl substances (PFAS)
	• Requires the department to…
	  ○ Identify priority consumer products that are a significant source of priority chemicals by June 1, 2020 and every 5 years thereafter
	  ○ Determine regulatory actions to increase transparency and reduce the use of priority chemicals in priority consumer products by June 1, 2022, and every 5 years thereafter
	  ○ Adopt rules to implement regulatory actions by June 1, 2023, and every 5 years thereafter
	  ○ Identify at least 5 new priority chemicals by June 1, 2024, and every 5 years thereafter
	• The following products may not be identified as priority consumer products:
	  ○ Plastic shipping pallets manufactured prior to 2012
	  ○ Food or beverages
	  ○ Tobacco products
	  ○ Drug or biological products regulated by the FDA
	  ○ Finished products certified or regulated by the Federal Aviation Administration or the Department of Defense, or both, when used in a manner that was certified or regulated by such agencies, including parts, materials, and processes when used to manufacture or maintain such regulated or certified finished products
	  ○ Motorized vehicles, including on and off-highway vehicles, such as all-terrain vehicles, motorcycles, side-by-side vehicles, farm equipment, and personal assistive mobility devices
	  ○ Chemical products used to produce an agricultural commodity
	• Requires manufacturers of children's products or consumer products containing a priority chemical subject to an adopted rule under this act to report the use of the chemical to the department

Category	• Identifies OFRs as hazardous chemicals • Requires reporting or data sharing
Relevant Products	Consumer products
Relevant OFRs	All OFRs
Implementing Agency	Washington Department of Ecology
Link to text	https://lawfilesext.leg.wa.gov/biennium/2019-20/Pdf/Bills/Senate%20Passed%20Legislature/5135-S.PL.pdf?q=20211124105048

Additional information:	https://ecology.wa.gov/Waste-Toxics/Reducing-toxic-chemicals/Safer-products: The Washington Department of Ecology developed the "Safer Products for Washington" Program to implement SB 5135 https://apps.ecology.wa.gov/publications/documents/2004019.pdf : Priority products identified in 2020

R.22 LEGAL TRENDS FACT SHEET: WASHINGTON D.C.

Relevant Law or Regulations:

Name	Carcinogenic Flame Retardant Prohibition Amendment Act of 2015: To amend the Human and Environmental Health Protection Act of 2010 to regulate the manufacture and sale of products containing carcinogenic flame retardants, to prohibit the use of chemicals known to be carcinogenic to humans, and to authorize the Department of Consumer and Regulatory Affairs to request and obtain a certificate of compliance with this act.
Citation	B21-0143
Status	Existing law
Date	Effective May 12, 2016
Description	Prohibits the sale, manufacture, or distribution of children's products and residential upholstered furniture containing TDCPP, TCPP, or TCEP, beginning January 1, 2016. Prohibits the sale, manufacture, or distribution of any product containing TDCPP, TCPP, or TCEP, beginning January 1, 2017. Prohibits the sale, manufacture, or distribution a product that substitutes a chemical prohibited by this act with a chemical that is reasonably anticipated to be a human carcinogen, likely to be carcinogenic to humans, or identified as causing birth defects, hormone disruption, neurotoxicity, or harm to reproduction or development. Does not apply to: o Selling, donating, or disposing of prohibited products acquired before the date of prohibition o Motor vehicles or replacement parts or equipment for motor vehicles o Commercial or residential building insulation or wiring o Desktop and laptop computers, audio and video equipment, calculators, wireless telephones, game consoles, handheld devices incorporating a screen used to access interactive software, and cables o Interactive software intended for leisure and entertainment Authorizes the Department of Consumer and Regulatory Affairs to request a certificate of compliance from manufacturers of relevant products • Within 30 days of the request, the manufacturer must provide a certificate of compliance or notify sellers and the Department that the product doesn't comply with the act
Category	• Restricts use of OFRs • Requires reporting or data sharing
Relevant Products	• Children's products • Residential upholstered furniture
Relevant OFRs	<u>Polyhalogenated organophosphates</u> • Tris(2-chloroethyl) phosphate (TCEP) (115-96-8) • Tris(2-chloroisopropyl) phosphate (TCPP) (13674-84-5) • Tris(1,3-dichloro-2-propyl) phosphate (TDCPP) (13674-87-8)
Implementing Agency	Department of Consumer and Regulatory Affairs

Link to text	https://legiscan.com/DC/text/B21-0143/id/1402548
Additional information:	

R.23 LEGAL TRENDS FACT SHEET: STATE OF WEST VIRGINIA

Relevant Law or Regulations:

Name	West Virginia Residential Furniture and Children's Products Flame Retardants Act: A bill to amend the Code of West Virginia, 1931, as amended, by adding thereto a new article, designated §16-63-1, §16-63-2, §16-63-3, §16-63-4, §16-63-5, §16-63-6, §16-63-7, §16-63-8, and §16-63-9, all relating to creating the West Virginia Residential Furniture and Children's Products Flame Retardants Act administered and enforced under the authority of the Commissioner of the Bureau for Public Health; prohibiting the use of certain flame-retardant chemicals in certain products; legislative findings; definitions; rule-making authority; when replacement chemicals may be used; exemptions to requirements; requiring report to Joint Committee on Government and Finance; requiring certificate of compliance; injunctive relief for violations; and providing civil penalties for violations.
Citation	HB 2126
Status	Pending legislation
Date	Effective July 1, 2021
Description	Beginning July 1, 2021, this law would prohibit manufacturers and wholesalers from manufacturing, selling, or distributing children's products and upholstered furniture containing regulated flame retardants in amounts greater than 1000 parts per 1,000,000. Beginning July 1, 2022, this law would prohibit retailers from selling such products. • Does not apply to: ○ Any previously owned products This law would prohibit manufacturers from replacing a prohibited flame retardant with a chemical known or suspected to… • Harm the normal development of a fetus or child or cause other developmental toxicity • Cause cancer, genetic damage, or reproductive harm • Disrupt the endocrine or hormone system; or • Damage the nervous system, immune system or organs, or cause other systemic toxicity The commissioner will develop an educational program to inform retailers regarding the requirements of this article. Additionally, the commissioner will develop a report on the status and use of flame retardants by January 15, 2022.
Category	• Restricts use of OFRs • Requires additional research of OFRs
Relevant Products	• Children's products • Upholstered furniture
Relevant OFRs	<u>Polyhalogenated diphenyl ethers</u> • Decabromodiphenyl ether (decaBDE) • Pentabromodiphenyl ether (pentaBDE)

Relevant OFRs	Polyhalogenated alicycles • Hexabromocyclododecane (HBCD) Polyhalogenated organophosphates • TCEP (tris (2-chloroethyl) phosphate) • TDCPP (tris (1, 3-dichloro-2propyl) phosphate)
Implementing Agency	West Virginia Bureau for Public Health
Link to text	http://www.wvlegislature.gov/Bill_Text_HTML/2021_SESSIONS/RS/bills/HB2126%20INTR.pdf
Additional information:	The Commissioner of the Bureau for Public Health can grant an exception to the provisions of this article if a regulated flame retardant meets one of the following conditions: 1. A technically feasible alternative is not available at a comparable cost 2. The potential harm to public health and the environment directly posed by a technically feasible alternative is greater than the potential harm caused by the regulated flame retardant

R.24 LEGAL TRENDS FACT SHEET: UNITED STATES

Relevant Law or Regulations:

Name	TSCA as amended by the Frank R. Lautenberg Chemical Safety Act of the 21st Century
Citation	15 U.S.C. §2601 et seq. (1976)
Status	Existing law
Date	Amended law effective June 22, 2016

Description	Section 4
	• Authorizes EPA to require testing of chemical substances where necessary to evaluate potential human health or environmental hazards
	Section 5
	• Requires pre-manufacture notifications for new chemical substances
	• Authorizes EPA to issue Significant New Use Rules (SNURs) when it identifies a significant new use that could result in exposure to, or releases of, a substance of concern
	Section 6
	• Authorizes EPA to regulate (including restricting or banning) the manufacture, importation, processing, distribution, use, and/or disposal of any chemical substance that presents an unreasonable risk of injury to human health or the environment
	• Directs EPA to take expedited action on certain persistent, bioaccumulative, and toxic chemical substances
	  ○ EPA issued a rule on February 5, 2021 to prohibit all manufacture, import, processing, and distribution in commerce of decaBDE, or decaBDE-containing products or articles, with some exclusions
	Section 8
	• Requires reporting and record-keeping by persons who manufacture, import, process, and/or distribute chemical substances in commerce
	  ○ Chemical Data Reporting Rule: Requires manufacturers (including importers) to report on chemicals if they meet certain production volume thresholds, generally 25,000 lbs or more of a chemical substance at any single site
	• Authorizes the EPA to gather unpublished chemical health and safety information from manufacturers (including importers), processors or distributors
	  ○ EPA issued a rule requiring manufacturers and importers of 50 specified chemicals, including 30 OFRs, to report certain lists and copies of unpublished health and safety studies by January 25, 2022
	• Requires that any person who manufactures, imports, processes, or distributes in commerce a chemical substance or mixture and who obtains information which reasonably supports the conclusion that such substance or mixture presents a substantial risk of injury to health or the environment to immediately inform EPA, except where EPA has been adequately informed of such information
	Section 13
	• Requires those importing or exporting chemicals to comply with certification reporting and/or other requirements

Category	• Requires reporting or data-sharing • Restricts use of OFRs
Relevant Products	Chemical substances and mixtures (excludes drugs, cosmetics, foods, food additives, pesticides, and nuclear materials)
Relevant OFRs	Prohibited: Polyhalogenated diphenyl ethers • decaBDE (1163-19-5) Subject to the Health and Safety Data Reporting rule: Polyhalogenated phthalates/benzoates/imides • Bis(2-ethylhexyl) tetrabromophthalate (26040-51-7) • 2-Ethylhexyl-2,3,4,5-tetrabromobenzoate (183658-27-7) • 2-(2-Hydroxyethoxy)ethyl 2-hydroxypropyl 3,4,5,6-tetrabromophthalate (20566-35-2) • N,N-Ethylene-bis(tetrabromophthalimide) (32588-76-4) Polyhalogenated carbocycles • Bis(hexachlorocyclopentadieno) cyclooctane (13560-89-9) Polyhalogenated phenol-aliphatic ether • 1,2-Bis(2,4,6-tribromophenoxy)ethane (37853-59-1) polyhalogenated benzene aliphatics and functionalized • 1,1′-Ethane-1,2-diylbis(pentabromobenzene) (84852-53-9) • (Pentabromophenyl)methyl acrylate (59447-55-1) • Pentabromotoluene (87-83-2) • 2,4,6-Tribromoaniline (147-82-0) Polyhalogenated bisphenol aliphatics and functionalized • 2,2′-[(1-Methylethylidene)bis[(2,6-dibromo-4,1-phenylene)oxymethylene]]bis[oxirane] (3072-84-2) • Tetrabromobisphenol A-bis(2,3-dibromopropyl ether) (21850-44-2) • Tetrabromobisphenol A bis(2-hydroxyethyl) ether (4162-45-2) • Tetrabromobisphenol A diallyl ether (25327-89-3) • Tetrabromobisphenol A dimethyl ether (37853-61-5) Polyhalogenated aliphatic chains • Mixture of chlorinated linear alkanes C14-17 with 45-52% chlorine (85535-85-9) Polyhalogenated alicycles • Pentabromochlorocyclohexane (87-84-3) Polyhalogenated diphenyl ethers • Perbromo-1,4-diphenoxybenzene (58965-66-5)

Relevant OFRs	Subject to the Health and Safety Data Reporting rule: Polyhalogenated organophosphates • Phosphonic acid, (2-chloroethyl)-, bis(2-chloroethyl) ester (6294-34-4) • Phosphoric acid, 2,2-bis(chloromethyl)-1,3-propanediyl tetrakis(2-chloroethyl) ester (38051-10-4) • Tris(2-chloroethyl)phosphite (140-08-9) • Tris(1-chloro-2-propyl)phosphate (13674-84-5) • Tris(2-chloro-1-propyl)phosphate (6145-73-9) • Tris(2,3-dibromopropyl)phosphate (126-72-7) • Tris(1,3-dichloro-2-propyl)phosphate (13674-87-8) • Tris(tribromoneopentyl)phosphate (19186-97-1) Polyhalogenated aliphatic carboxylate • Propanoic acid, 2-bromo-, methyl ester (5445-17-0) Polyhalogenated phenol-aliphatic ether • 1,3,5-Tribromo-2-(prop-2-en-1-yloxy)benzene (3278-89-5) Polyhalogenated triazines • 1,3,5-Tris(2,3-dibromopropyl)-1,3,5-triazine-2,4,6(1H,3H,5H)-trione (52434-90-9) • 2,4,6-Tris-(2,4,6-tribromophenoxy)-1,3,5-triazine (25713-60-4)
Implementing Agency	U.S. Environmental Protection Agency
Link to text	http://uscode.house.gov/view.xhtml?path=/prelim@title15/chapter53&edition=prelim
Additional information:	https://www.congress.gov/114/plaws/publ182/PLAW-114publ182.pdf : Frank Lautenberg Act, enacted June 2016 https://www.regulations.gov/document/EPA-HQ-OPPT-2020-0474-0001 : Addition of 20 High-Priority Substances and 30 Organohalogen Flame Retardants to TSCA Health and Safety Data Reporting Rule https://www.federalregister.gov/documents/2021/01/06/2020-28686/decabromodiphenyl-ether-decabde-regulation-of-persistent-bioaccumulative-and-toxic-chemicals-under : decaBDE prohibition
Name	Federal Hazardous Substance Act
Citation	15 U.S.C. §§1261−1278
Status	Existing law
Date	Enacted 1960, most recently amended in 2011
Description	• Requires cautionary labeling of hazardous household substances intended or packaged for household use • Bans products intended for children that are or contain a hazardous substance a child can access • Authorizes CPSC to regulate or ban a hazardous substance, and toys or other articles intended for use by children, under certain circumstances to protect the public

Category	
Relevant Products	• Household products • Children's products
Relevant OFRs	
Implementing Agency	Consumer Product Safety Commission
Link to text	https://www.law.cornell.edu/cfr/text/16/chapter-II/subchapter-C https://www.cpsc.gov/s3fs-public/pdfs/blk_pdf_fhsa.pdf
Additional information:	https://www.cpsc.gov/Business--Manufacturing/Business-Education/Business-Guidance/FHSA-Requirements : More information on FHSA

R.25 LEGAL TRENDS FACT SHEET: CANADA

Relevant Law or Regulations:

Name	Canadian Environmental Protection Act, 1999 (CEPA 1999)
Citation	S.C. 1999, c. 33
Status	Existing law
Date	Effective March 31, 2000

Description	Chapter 5 (Existing substances)
	• Establishes processes to categorize and screen the Domestic Substances List, a list of substances that can be manufactured in, imported into, or used in Canada that have not been assessed for the risks they pose to the environment or human health
	• Establishes process to assess the Priority Substances List, a list of chemicals that require investigation on a priority and in-depth basis to determine if they are toxic
	• Priority substances may be added to the List of Toxic Substances (Schedule 1 of the act) or the Virtual Elimination List
	  ○ Placement on Schedule 1 allows the government to proceed with regulations, pollution prevention plans, or environmental emergency plans
	  ▪ The Prohibition of Certain Toxic Substances Regulations were developed under CEPA, 1999 to prohibit certain toxic substances
	  ○ Substances on the Virtual Elimination list are designed to be virtually eliminated
	
	Chapter 6 (New substances)
	• Requires manufacturers and importers to notify the Minister prior to manufacturing or importing new substances
	  ○ Must provide relevant information needed for an assessment of potential toxicity
	• Significant New Activity (SNAc) provisions trigger an obligation for a person to provide the Government of Canada with information about a substance when proposing to use, import or manufacture the substance for a significant new activity

Category	• Restricts use of OFRs • Requires reporting or data sharing
Relevant Products	Chemical substances
Relevant OFRs	Prohibited by the Prohibition of Certain Toxic Substances Regulations: <u>Polyhalogenated diphenyl ethers</u> • Heptabromo diphenyl ether (68928-80-3) • Nonabromo diphenyl ether (63936-56-1) • Tetrabromo diphenyl ether (40088-47-9) • Hexabromo diphenyl ether (36483-60-0) • octabromodiphenyl ether (32536-52-0) • Pentabromo diphenyl ether (32534-81-9) • Decabromo diphenyl ether (1163-19-5)

Relevant OFRs	Prohibited by the Prohibition of Certain Toxic Substances Regulations: Polyhalogenated benzenes • Tetrabromo(tetra bromophenyl) benzene (27858-07-7) • Hexabromo biphenyl (HBB) (36355-01-8) • Decabromo biphenyl (13654-09-6) Polyhalogenated alicycles • Hexabromocyclo dodecane (HBCD) (3194-55-6) Subject to Significant New Activity (SNAc) provisions: Polyhalogenated phenol derivatives • Phenol, pentabromo- (608-71-9) Polyhalogenated aliphatic chains • 1,3-Propanediol, 2,2-bis(bromomethyl)- (3296-90-0) Polyhalogenated carbocycles • Bicyclo[2.2.1]hept-5-ene-2,3-dicarboxylic acid, 1,4,5,6,7,7-hexachloro- (115-28-6)
Implementing Agency	Health Canada Environment Canada
Link to text	https://laws-lois.justice.gc.ca/eng/acts/c-15.31/index.html
Additional information:	https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/summary-flame-retardant-assessments-management-conducted-cepa.html : Summary of flame retardant assessments and management conducted under the CEPA https://laws-lois.justice.gc.ca/eng/acts/c-15.31/PITIndex.html : Previous versions of CEPA Prohibition of Certain Toxic Substances Regulations, 2012 (justice.gc.ca) : Prohibition of Certain Toxic Substances Regulations

Name	Canada Consumer Product Safety Act (CCPSA)
Citation	S.C. 2010, c. 21
Status	Existing law
Date	Effective June 20, 2011
Description	Prohibits the manufacture, import, advertisement, or sale of any consumer product that is a danger to human health or safety Schedule 2 to the CCPSA: • Prohibits the manufacture, import, advertisement or sale of products made in whole or in part of textile fibres, intended for use as wearing apparel, that are treated with or contain tris (2,3 dibromopropyl) phosphate as a single substance or as part of a chemical compound • Prohibits the manufacture, import, advertisement or sale of products that are made, in whole or in part, of polyurethane foam that contains tris (2-chloroethyl) phosphate and that are intended for a child under three years of age (added in 2014 amendment) Children's Sleepwear Regulations: • Loose-fitting sleepwear that is treated with a flame retardant, any component that is extracted or broken down from such treated sleepwear and any flame retardant that is used to treat the sleepwear must meet specific requirements that protect against acute and chronic toxicity • Requires specific labelling requirements for loose-fitting sleepwear that is treated with a flame retardant
Category	Restricts use of OFRs
Relevant Products	Consumer products
Relevant OFRs	Schedule 2 substances: Polyhalogenated organophosphates • (chloroethyl) phosphate (TCEP) (115-96-8) • Tris(2,3-dibromopropyl) phosphate (126-72-7) Children's sleepwear regulations: • All OFRs
Implementing Agency	Health Canada
Link to text	https://laws-lois.justice.gc.ca/eng/acts/C-1.68/

Additional information:	https://www.canada.ca/en/health-canada/services/consumer-product-safety/legislation-guidelines/guidelines-policies/notice-stakeholders-flame-retardant-chemicals-certain-consumer-products.html : Summary of current prohibitions and restrictions concerning the use of flame retardant chemicals under the CCPSA https://gazette.gc.ca/rp-pr/p2/2014/2014-04-23/html/sor-dors79-eng.html#:~:text=As%20TCEP%20has%20been%20identified%20in%20children%E2%80%99s%20products%2C,provides%20the%20authority%20to%20enact%20such%20a%20prohibition.: Regulations Amending Schedule 2 to the Canada Consumer Product Safety Act (TCEP) https://laws-lois.justice.gc.ca/eng/regulations/SOR-2016-169/index.html : Children's Sleepwear Regulations https://www.canada.ca/en/health-canada/services/chemical-substances/chemicals-management-plan.html: Information on the Chemicals Management Plan, an initiative created in 2006 to assess environmental and human health risks posed by chemical substances and develop risk management measures https://laws-lois.justice.gc.ca/eng/acts/C-1.68/PITIndex.html : Previous versions of the CCPSA

R.26 LEGAL TRENDS FACT SHEET: EUROPEAN UNION

Relevant Law or Regulations:

Name	Amending for the 24th time Council Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations (pentabromodiphenyl ether, octabromodiphenyl ether)
Citation	Directive 2003/11/EC
Status	Existing law
Date	• Member states must adopt and publish laws and regulations to comply with the directive by February 15, 2004 • They shall apply those measures with effect from August 15, 2004
Description	Prohibits the sale of substances or articles containing pentaBDE or decaBDE in concentrations higher than 0.1% by mass
Category	Restricts use of OFRs
Relevant Products	All/ any products
Relevant OFRs	Polyhalogenated diphenyl ethers • pentaBDE • octaBDE
Link to text	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32003L0011
Additional information:	Repealed by Regulation (EC) No 1907/2006 (REACH); No longer in force, Date of end of validity: 5/31/2009

Name	Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast)
Citation	
Status	Existing law
Date	Member states must adopt laws and regulations to comply with this directive by January 2, 2013
Description	Prohibits electrical and electronic equipment placed on the market, including cables and spare parts used for repair, from containing the following substances: • Lead, mercury, hexavalent chromium, PBB, and PBDE in concentrations greater than 0.1% by weight in homogenous materials • Cadmium in concentrations greater than 0.01% by weight in homogenous materials Does not apply to: • Equipment with specifically military purposes • Space equipment • Equipment which is specifically designed, and is to be installed, as part of another type of equipment that is excluded or does not fall within the scope of this Directive, which can fulfil its function only if it is part of that equipment, and which can be replaced only by the same specifically designed equipment; • Large-scale stationary industrial tools • Large-scale fixed installations • Means of transport for persons or goods, excluding electric two-wheel vehicles which are not type-approved • Non-road mobile machinery made available exclusively for professional use • Active implantable medical devices • Photovoltaic panels intended to be used in a system that is designed, assembled and installed by professionals for permanent use at a defined location to produce energy from solar light for public, commercial, industrial and residential applications; • Equipment specifically designed solely for the purposes of research and development only made available on a business-to-business basis Places legal obligations on manufacturers, authorized representatives, importers, and distributors to demonstrate compliance
Category	Restricts use of OFRs
Relevant Products	Electrical and electronic equipment
Relevant OFRs	• Polybrominated biphenyls • Polybrominated diphenyl ethers
Link to text	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32011L0065 : Original text https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02011L0065-20211101 : Most recent version of text

Additional information:	'Electrical and electronic equipment' or 'EEE' means equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents and fields and designed for use with a voltage rating not exceeding 1,000 volts for alternating current and 1,500 volts for direct current.

Name	Regulation (EC) No 1907/2006 Of The European Parliament And Of The Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC
Citation	
Status	Existing law
Date	Enacted December 18, 2006

Description	• Requires companies to register substances they manufacture or import above one tonne a year through a registration dossier
	  ○ Companies must assess the risks the substance may pose and how to control these risks
	• Member states perform substance evaluations to clarify whether the substance may cause harm
	• Chemicals with the following criteria may be categorized as substances of very high concern (SVHCs) and included on the Candidate List:
	  ○ Substances meeting the criteria for classification as carcinogenic, mutagenic or toxic for reproduction (CMR) category 1A or 1B in accordance with the CLP Regulation
	  ○ Substances which are persistent, bioaccumulative and toxic (PBT) or very persistent and very bioaccumulative (vPvB) according to REACH Annex XIII
	  ○ Substances on a case-by-case basis, that cause an equivalent level of concern as CMR or PBT/vPvB substances
	• The inclusion in the Candidate List brings immediate obligations for suppliers of the substance, such as:
	  ○ supplying a safety data sheet
	  ○ communicating on safe use
	  ○ responding to consumer requests within 45 days and
	  ○ notifying ECHA if the article they produce contains an SVHC in quantities above one tonne per producer/importer per year and if the substance is present in those articles above a concentration of 0.1% (w/w)
	• ECHA assesses substances from the Candidate List to determine which should be included in the Authorisation List (Annex XIV) as a priority
	  ○ Substances on the Authorisation List may only be used or placed on the market after a specific authorization has been granted
	• Requires suppliers of articles containing a substance in Annex XIV in a concentration above 0.1 % weight by weight (w/w) to provide the recipient of the article with sufficient information, available to the supplier, to allow safe use of the article including, as a minimum, the name of that substance.
	• Annex XVII sets restrictions on the manufacture, placing on the market, and use of certain dangerous substances, preparations and articles

Category	• Identifies OFRs as hazardous chemicals • Requires reporting or data sharing • Restricts use of OFRs
Relevant Products	All/ any products

Relevant OFRs	Listed on the Candidate List: Polyhalogenated aliphatic chains • Alkanes, C14-16, chloro (1372804-76-6) • Alkanes, C14-17, chloro (85535-85-9) • TBNPA (1522-92-5) • BMP (3296-90-0) Polyhalogenated carbocycles • (1S,2S,5R,6R,9S,10S,13R,14R)-1,6,7,8,9,14,15,16,17,17,18,18-Dodecachloropentacyclo[12.2.1.1^{6,9}.0^{2,13}.0^{5,10}]octadeca-7,15-diene (135821-03-3) • (1S,2S,5S,6S,9R,10R,13R,14R)-1,6,7,8,9,14,15,16,17,17,18,18-Dodecachloropentacyclo[12.2.1.1^{6,9}.0^{2,13}.0^{5,10}]octadeca-7,15-diene (135821-74-8) • 1,6,7,8,9,14,15,16,17,17,18,18-dodecachloropentacyclo[12.2.1.16,9.02,13.05,10]octadeca-7,15-diene (13560-89-9) Listed on the Authorisation List (Annex XIV): Polyhalogenated alicycles • Gamma-hexabromocyclododecane (134237-52-8) • Beta-hexabromocyclododecane (134237-51-7) • Hexabromocyclododecane (25637-99-4) • 1,2,5,6,9,10-hexabromocyclododecane (3194-55-6) • Alpha-hexabromocyclododecane (134237-50-6) Polyhalogenated organophosphates • Tris(2-chloroethyl) phosphate (115-96-8) Substances restricted under REACH (Annex XVII): Polyhalogenated organophosphates • Tris (2,3 dibromopropyl) phosphate (126-72-7) Polyhalogenated benzenes • Polybromobiphenyls, Polybrominatedbiphenyls (PBB) (59536-65-1) • Tetrabromo(tetrabromophenyl)benzene (27858-07-7) • Decabromo-1,1'-biphenyl (13654-09-6) • 4-bromobiphenyl (92-66-0) • 4,4'-dibromobiphenyl (92-86-4) • 3-bromobiphenyl (2113-57-7) • Hexabromo-1,1'-biphenyl (36355-01-8) Polyhalogenated diphenyl ethers • Diphenyl ether, octabromo derivative (32536-52-0) Note that Regulation (EU) No 207/2011 removed pentaBDE from Annex XVII in 2011 Regulation (EU) No 126/2013 removed short chain chlorinated paraffins were removed from Annex XVII in 2013

Implementing Agency	European Chemicals Agency (ECHA)
Link to text	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02006R1907-20140410
Additional information:	https://echa.europa.eu/regulations/reach/legislation: More information on implementation of REACH https://echa.europa.eu/candidate-list-table: Candidate List of substances of very high concern for Authorisation https://www.echa.europa.eu/authorisation-list: Authorisation List

Name	Commission Directive 2014/79/EU of 20 June 2014 amending Appendix C of Annex II to Directive 2009/48/EC of the European Parliament and of the Council on the safety of toys, as regards TCEP, TCPP and TDCP
Citation	
Status	Existing law
Date	• Member states must adopt and publish laws and regulations to comply with the directive by December 21, 2015 • They shall apply those measures with effect from December 21, 2015
Description	Prohibits toys intended for use by children under 36 months or in other toys intended to be placed in the mouth containing TCEP, TCPP, or TDCP in amounts greater than 5 mg/kg
Category	Restricts use of OFRs
Relevant Products	Children's products
Relevant OFRs	Polyhalogenated organophosphates • TCEP (115-96-8) • TCPP (13674-84-5) • TDCP (13674-87-8)
Link to text	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0079
Additional information:	https://ec.europa.eu/growth/sectors/toys/toy-safety/legislation_en : More information on EU toy safety legislation

Name	Commission Regulation (EU) 2019/2021 of 1 October 2019 laying down ecodesign requirements for electronic displays pursuant to Directive 2009/125/EC of the European Parliament and of the Council, amending Commission Regulation (EC) No 1275/2008 and repealing Commission Regulation (EC) No 642/2009
Citation	
Status	Existing law
Date	Effective March 1, 2021
Description	Prohibits the use of halogenated flame retardants in the enclosure and stand of electronic displays Requires plastic components containing flame retardants to be marked with the abbreviated term of the polymer followed by hyphen, then the symbol 'FR' followed by the code number of the flame retardant in parentheses Requires product manufacturers to make the following information available when placing on the market the first unit of a model or of an equivalent model: The information shall be provided free of charge to third parties dealing with professional repair and reuse of electronic displays (including third party maintenance actors, brokers and spare parts providers). Does not apply to: • any electronic display with a screen area smaller than or equal to 100 square centimetres; • projectors; • all-in-one video conference systems; • medical displays; • virtual reality headsets; • displays integrated or to be integrated into products listed into Article 2, point 3(a) and point 4 of Directive 2012/19/EU; • displays that are components or subassemblies of products covered by implementing measures adopted under Directive 2009/125/EC
Category	Restricts use of OFRs
Relevant Products	Electronic displays
Relevant OFRs	All OFRs
Link to text	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R2021-20210501
Additional information:	'Halogenated flame retardant' means a flame retardant that contains any halogen

R.27 LEGAL TRENDS FACT SHEET: JAPAN

Relevant Law or Regulations:

Name	Act on Control of Household Products Containing Harmful Substances
Citation	Act No. 112 of 1973
Status	Existing law
Date	Enacted October 12, 1973
Description	• Authorizes the Ministry of Health, Labour and Welfare to designate products as containing "harmful substances" • Prohibits businesses from manufacturing, importing, or selling household products containing harmful substances • Authorizes the Ministry of Health, Labour and Welfare to develop regulations to enforce this act, recall products containing harmful substances, and inspect businesses
Category	• Restricts use of OFRs • Requires reporting or data sharing
Relevant Products	Household products
Relevant OFRs	Listed harmful substances: <u>Polyhalogenated organophosphates</u> • Bis (2, 3-dibromopropyl) phosphates [BDBPP] (5412-25-9) • Tris (2, 3-dibromopropyl) phosphate [TDBPP] (126-72-7)
Implementing Agency	Ministry of Health, Labour and Welfare
Link to text	http://extwprlegs1.fao.org/docs/pdf/jap117012.pdf
Additional information:	http://www.nihs.go.jp/mhlw/chemical/katei/PDF/160629_list_eiyaku.pdf: List of prohibited household products containing harmful substances • Bis (2, 3-dibromopropyl) phosphates [BDBPP] prohibited in textile products, effective September 1st, 1981 • TDBPP prohibited in textile products, effective November 1st, 1978

Name	Act on the Regulation of Manufacture and Evaluation of Chemical Substances
Citation	Act No. 117 of 1973
Status	Existing law
Date	Enacted October 16, 1973
Description	• Manufacturers or importers must notify the Minister of Health, Labour and Welfare, the Minister of Economy, Trade and Industry, and the Minister of the Environment before new chemical substances are manufactured or imported • Chemicals are classified into the following groups: o Class I Chemical Substance ▪ Definition: persistent, highly bio-accumulative, and has a risk of long-term toxicity to humans ▪ Manufacture and importation of these chemicals is not allowed without permission o Class II Specified Chemical Substance ▪ Definition: has a risk of long-term toxicity for humans or environment ▪ Notification required prior to manufacturing and importing these substances o Priority Assessment Chemical Substances ▪ Definition: Chemicals identified with higher priority in terms of risk assessment for human health ▪ Annual reporting of the volume of manufacture and import required o Monitoring Chemical Substances ▪ Definition: Existing chemicals that are bioaccumulative, but have unknown toxicities ▪ Annual reporting of the use and quantity is required after manufacture and import o General Chemicals ▪ Definition: Chemicals that don't fall under any of the preceding classifications ▪ Annual reporting of volume imported and manufactured required
Category	• Restricts use of OFRs • Identifies OFRs as hazardous chemicals
Relevant Products	Chemical substances
Relevant OFRs	Listed Class I Specified Chemicals <u>Polyhalogenated alicycles</u> • 1,2,5,6,9,10-Hexabromocyclododecane (3194-55-6) • Hexabromocyclododecane (25637-99-4) • rel-(1R,2R,5S,6R,9R,10S)-1,2,5,6,9,10-Hexabromocyclododecane (134237-50-6) • rel-(1R,2S,5R,6R,9R,10S)-1,2,5,6,9,10-Hexabromocyclododecane (134237-51-7) • rel-(1R,2R,5R,6S,9S,10R)-1,2,5,6,9,10-Hexabromocyclododecane (134237-52-8) • (1R,2R,5R,6S,9R,10S)-1,2,5,6,9,10-Hexabromocyclododecane (138257-18-8) • (1R,2S,5S,6R,9S,10S)-1,2,5,6,9,10-Hexabromocyclododecane (138257-19-9) • (1R,2S,5S,6S,9S,10R)-1,2,5,6,9,10-Hexabromocyclododecane (169102-57-2) • (1R,2R,5S,6R,9R,10S)-1,2,5,6,9,10-Hexabromocyclododecane (678970-15-5) • (1R,2S,5R,6S,9S,10S)-1,2,5,6,9,10-Hexabromocyclododecane (678970-16-6) • (1R,2R,5R,6S,9S,10R)-1,2,5,6,9,10-Hexabromocyclododecane (678970-17-7) • Cyclododecane, 1,3,5,7,9,11-hexabromo- (1093632-34-8)

Relevant OFRs	Listed Class I Specified Chemicals Polyhalogenated aliphatic chains • Chloroalkanes (61788-76-9) • Paraffin waxes and Hydrocarbon waxes, chloro (63449-39-8) • Chloroalkanes(C=6-18) (68920-70-7) • Chloroalkanes(C=12-13) (71011-12-6) • Chloroalkanes(C=10-21) (84082-38-2) • Chloroalkanes(C=10-32) (84776-06-7) • Chloroparaffin oils (85422-92-0) • Chloroalkanes(C=10-13) (85535-84-8) • Chloroalkanes(C=12-14) (85536-22-7) • Chloroalkanes(C=10-14) (85681-73-8) • Chloroparaffins(C>10, linear chain, petroleum) (97553-43-0) • Chloroalkanes(C=10-26) (97659-46-6) • Alkanes, C10-12, chloro (108171-26-2) Polyhalogenated benzenes • Hexabromobiphenyl (36355-01-8) • 2,2',4,4',5,5'-Hexabromobiphenyl (59080-40-9) • 3,3',4,4',5,5'-Hexabromobiphenyl (60044-26-0) • 2,2',3,4,4',5'-Hexabromobiphenyl (67888-98-6) • 2,3',4,4',5,5'-Hexabromobiphenyl (67888-99-7) • 2,2',3,4',5',6-Hexabromobiphenyl (69278-59-7) • 2,2',3,3',4,4'-Hexabromobiphenyl (82865-89-2) • 2,3',4,4',5',6-Hexabromobiphenyl (84303-48-0) Polyhalogenated carbocycles • Perchloronaphthalene (2234-13-1) • Perchloropentacyclo[5.3.0.0(2,6).0(3,9).0(4,8)]decane (2385-85-5)
Relevant OFRs	Listed Class I Specified Chemicals Polyhalogenated diphenyl ethers • Decabromo-1,1'-oxybis(benzene) (1163-19-5) • 2,4-Dibromo-1-(2,4-dibromophenoxy)benzene (5436-43-1) • Pentabromo(phenoxybenzene) (32534-81-9) • 1,3,5-Tribromo-2-(2,4,6-tribromophenoxy)benzene (35854-94-5) • Hexabromo(phenoxybenzene) (36483-60-0) • Tetrabromo(phenoxybenzene) (40088-47-9) • 1,2,4-Tribromo-5-(2,4-dibromophenoxy)benzene (60348-60-9) • 1,2,4-Tribromo-5-(2,4,5-tribromophenoxy)benzene (68631-49-2) • Heptabromo(phenoxybenzene) (68928-80-3) • 1,2-Dibromo-4-(3,4-dibromophenoxy)benzene (93703-48-1) • 1,3-Dibromo-5-(3,5-dibromophenoxy)benzene (103173-66-6) • 1,2,4,5-Tetrabromo-3-(2,4,6-tribromophenoxy)benzene (116995-32-5) • 1,2,4,5-Tetrabromo-3-(2,4-dibromophenoxy)benzene (116995-33-6) • 1,2,3,5-Tetrabromo-4-(2,4,6-tribromophenoxy)benzene (117948-63-7) • 1,2,3,4,5-Pentabromo-6-phenoxybenzene (189084-65-9) • 1,3,5-Tribromo-2-(2,4,5-tribromophenoxy)benzene (207122-15-4) • 1,2,3,5-Tetrabromo-4-(2,4,5-tribromophenoxy)benzene (207122-16-5) • 1,2,3,5-Tetrabromo-4-(2,3,5-tribromophenoxy)benzene (446255-22-7)

Relevant OFRs	Listed Monitoring Chemical Substances: Polyhalogenated diphenyl ethers • Benzene, 1,3,5-tribromo-2-(2,3-dibromo-2-methylpropoxy)- (36065-30-2) Polyhalogenated benzenes • 2,4,5-Tribromobiphenyl (115245-07-3) • 3,3',4,4',5-Pentabromobiphenyl (84303-46-8) • 4,4'-Dibromobiphenyl (92-86-4) • 3,3',5,5'-Tetrabromobiphenyl (16400-50-3) • 2,2',4,5'-Tetrabromobiphenyl (60044-24-8) • 3,3',4,4'-Tetrabromobiphenyl (77102-82-0) • 2,3',4,4',5-Pentabromobiphenyl (67888-97-5) • 2,2',4,5,5'-Pentabromobiphenyl (67888-96-4) • 2,2',5,6'-Tetrabromobiphenyl (60044-25-9) • 2,2',4,5',6-Pentabromobiphenyl (59080-39-6) • 2,2',5,5'-Tetrabromobiphenyl (59080-37-4) No OFRs are listed as Class II chemicals.
Implementing Agency	• Ministry of Economy, Trade, and Industry (METI) • Ministry of Labor and Welfare (MHLW) • Ministry of the Environment (MOE)
Link to text	http://www.japaneselawtranslation.go.jp/law/detail/?id=3350&vm=02&re=01
Additional information:	https://www.meti.go.jp/policy/chemical_management/law/msds/sin1shueng.pdf: List of Class I Specified Chemicals https://www.nite.go.jp/en/chem/chrip/chrip_search/intSrhSpcLst?_e_trans=&slScNm=RJ_01_002: List of Class II Designated Chemicals https://www.nite.go.jp/en/chem/chrip/chrip_search/intSrhSpcLst?_e_trans=&slScNm=RJ_01_010: List of Monitoring Chemical Substances https://www.nite.go.jp/en/chem/chrip/chrip_search/intSrhSpcLst?_e_trans=&slScNm=RJ_01_020: List of Priority Assessment Chemical Substances

APPENDIX S | SIGMA ALDRICH PRICE DATA

CAS Number	OFR_Chemical_Name	OFR_NAS_Category	SKU	Pack Size	Availability	Listed Price (per pack) in USD	Conversion Factor	Comp Tox Density (from Dashboard)	Price per gram in USD
134237-52-8	(+/-)-gamma-Hexabromocyclododecane	polyhalogenated alicycles	73709-25MG	25 MG	Estimated to ship on January 03, 2022	$371.00	0.025		$14,840.00
134237-50-6	(+/-)-?-Hexabromocyclododecane	polyhalogenated alicycles	30373-25MG	25 MG	Estimated to ship on December 09, 2021	$361.00	0.025		$14,440.00
134237-51-7	(+/-)-beta-Hexabromocyclododecane	polyhalogenated alicycles	01986-25MG	25 MG	Estimated to ship on December 09, 2021	$317.00	0.025		$12,680.00
1837-91-8	Benzene hexabromide	polyhalogenated alicycles	SML0455-50MG	50 MG	Estimated to ship on December 13, 2021	$127.00	0.05		$2,540.00
77-47-4	Hexachlorocyclopentadiene	polyhalogenated alicycles	CRM143-50G	50 G	Available to ship on November 18, 2021 - From	$194.00	50		$3.88
3194-55-6	1,2,5,6,9,10-Hexabromocyclododecane	polyhalogenated alicycles	144762-25G	25 G	Available to ship on November 18, 2021 - From	$23.10	25		$0.92
5445-17-0	Propanoic acid, 2-bromo-, methyl ester	polyhalogenated aliphatic carboxylate	167185-100G	100 G	Estimated to ship on February 11, 2022	$67.10	100		$0.67
1522-92-5	3-Bromo-2,2-bis(bromomethyl)propanol	polyhalogenated aliphatic chains	S578312-50MG	50 MG	Usually ships in 2 business days. (Orders outside of US, please allow an additional 1-2 weeks for delivery)	$153.00	0.05		$3,060.00
3234-02-4	2,3-Dibromo-2-butene-1,4-diol	polyhalogenated aliphatic chains	143707-100G	100 G	Available to ship on November 18, 2021 - From	$70.20	100		$0.70
96-13-9	2,3-Dibromopropanol	polyhalogenated aliphatic chains	D43050-500G	500 G	Available to ship on November 18, 2021 - From	$179.00	500		$0.36
79-27-6	1,1,2,2-Tetrabromoethane	polyhalogenated aliphatic chains	185574-1KG	1 KG	Estimated to ship on November 29, 2021	$108.00	1000		$0.11
3296-90-0	Pentaerythritol dibromide	polyhalogenated aliphatic chains	301930-1KG	1 KG	Available to ship on November 18, 2021 - From	$106.00	1000		$0.11
87-83-2	Pentabromotoluene	polyhalogenated benzene aliphatics and functionalized	07444-50MG	50 MG	Only 2 left in stock (more on the way) - From	$79.60	0.05		$1,592.00
59447-55-1	(Pentabromophenyl)methyl acrylate	polyhalogenated benzene aliphatics and functionalized	640263-5G	5 G	Only 6 left in stock (more on the way) - From	$1,010.00	5		$202.00
38521-51-6	1,2,3,4,5-Pentabromo-6-(bromomethyl)benzene	polyhalogenated benzene aliphatics and functionalized	S17427-1G	1 G	Usually ships in 2 business days. (Orders outside of US, please allow an additional 1-2 weeks for delivery)	$153.00	1		$153.00
147-82-0	2,4,6-Tribromoaniline	polyhalogenated benzene aliphatics and functionalized	163694-100G	100 G	Estimated to ship on January 13, 2022	$60.40	100		$0.60
93-52-7	1,2-dibromo(phenyl)ethane	polyhalogenated benzene aliphatics and functionalized	178012-500G	500 G	Estimated to ship on November 29, 2021	$208.00	500		$0.42

CAS Number	OFR_Chemical_Name	OFR_NAS_Category	SKU	Pack Size	Availability	Listed Price (per pack) in USD	Conversion Factor	Comp Tox Density (from Dashboard)	Price per gram in USD
608-90-2	Benzene, pentabromo-	polyhalogenated benzenes	S111023-100MG	100 MG	Usually ships in 2 business days. (Orders outside of US, please allow an additional 1-2 weeks for delivery)	$153.00	0.1		$1,530.00
59447-57-3	Poly(pentabromobenzyl acrylate)	polyhalogenated benzenes	640328-500MG	500 MG	Estimated to ship on December 13, 2021	$370.00	0.5		$740.00
2113-57-7	3-Bromobiphenyl	polyhalogenated benzenes	255386-5G	5 G	Available to ship on December 01, 2021 - FROM	$35.40	5		$7.08
87-82-1	Hexabromobenzene	polyhalogenated benzenes	107131-25G	25 G	Only 4 left in stock (more on the way) - From	$72.00	25		$2.88
92-66-0	4-Bromobiphenyl	polyhalogenated benzenes	281999-10G	10 G	Only 5 left in stock (more on the way) - From	$24.00	10		$2.40
636-28-2	1,2,4,5Tetrabromobenzene	polyhalogenated benzenes	278343-100G	100 G	Estimated to ship on January 19, 2022	$209.00	100		$2.09
626-39-1	1,3,5Tribromobenzene	polyhalogenated benzenes	140066-100G	100 G	Only 4 left in stock (more on the way) - FROM	$150.00	100		$1.50
92-86-4	1,1'-Biphenyl, 4,4'-dibromo-	polyhalogenated benzenes	229237-100G	100 G	Available to ship on November 18, 2021 - From	$67.90	100		$0.68
79-95-8	2,2',6,6'-Tetrachlorobisphenol A	polyhalogenated bisphenol aliphatics and functionalized	73081-10MG	10 MG	Only 2 left in stock (more on the way) - From	$122.00	0.01		$12,200.00
21850-44-2	Tetrabromobisphenol A-bis(2,3-dibromopropyl ether)	polyhalogenated bisphenol aliphatics and functionalized	S509574-250MG	250 MG	Usually ships in 2 business days. (Orders outside of US, please allow an additional 1-2 weeks for delivery)	$153.00	0.25		$612.00
4162-45-2	Tetrabromobisphenol A bis(2-hydroxyethyl) ether	polyhalogenated bisphenol aliphatics and functionalized	194433-100G	100 G	Available to ship on November 18, 2021 - From	$77.70	100		$0.78
79-94-7	3,3',5,5'-Tetrabromobisphenol A	polyhalogenated bisphenol aliphatics and functionalized	330396-100G	100 G	Available to ship on November 18, 2021 - From	$57.60	100		$0.58
2234-13-1	1,2,3,4,5,6,7,8-Octachloronaphthalene	polyhalogenated carbocycles	442725	20 MG	Available to ship on December 01, 2021 - FROM	$75.50	0.02		$3,775.00
2385-85-5	Mirex	polyhalogenated carbocycles	36170-100MG	100 MG	Only 6 left in stock (more on the way) - From	$57.80	0.1		$578.00
115-28-6	Chlorendic acid	polyhalogenated carbocycles	411701-10G	10 G	Available to ship on November 18, 2021 - From	$40.40	10		$4.04

CAS Number	OFR_Chemical_Name	OFR_NAS_Category	SKU	Pack Size	Availability	Listed Price (per pack) in USD	Conversion Factor	Comp Tox Density (from Dashboard)	Price per gram in USD
115-27-5	Chlorendic anhydride	polyhalogenated carbocycles	103268-100G	100 G	Only 2 left in stock (more on the way) - From	$51.50	100		$0.52
41318-75-6	2,4,4'-Tribromodiphenyl ether	polyhalogenated diphenyl ethers	05364-10MG	10 MG	Available to ship on November 19, 2021 - From	$216.00	0.01		$21,600.00
5436-43-1	2,2',4,4'-Tetrabromodiphenyl ether	polyhalogenated diphenyl ethers	91834-10MG	10 MG	Available to ship on November 18, 2021 - From	$213.00	0.01		$21,300.00
60348-60-9	2,2',4,4',5-Pentabromodiphenyl ether	polyhalogenated diphenyl ethers	42235-10MG	10 MG	Available to ship on November 18, 2021 - From	$172.00	0.01		$17,200.00
147217-81-0	BDE-37	polyhalogenated diphenyl ethers	91408-10MG	10 MG	Estimated to ship on December 23, 2021	$134.00	0.01		$13,400.00
7025-06-1	Benzene, bromophenoxy-	polyhalogenated diphenyl ethers	43691-10MG	10 MG	Estimated to ship on December 22, 2021	$83.30	0.01		$8,330.00
32577-34-7	Benzene, pentabromo(2,3dibromopropoxy)	polyhalogenated diphenyl ethers	S508659-250MG	250 MG	Usually ships in 2 business days. (Orders outside of US, please allow an additional 1-2 weeks for delivery)	$153.00	0.25		$612.00
147217-79-6	1,3-Dibromo-5-(3-bromophenoxy)benzene	polyhalogenated diphenyl ethers	33664-1ML	1 ML	Estimated to ship on December 23, 2021	$435.00	2.03	Converted to Grams using Density of 2.03 G/ML	$214.29
243982-82-3	2,2',4,5'-Tetrabromodiphenyl Ether	polyhalogenated diphenyl ethers	33671-1ML	1 ML	Only 2 left in stock (more on the way) - FROM	$435.00	2.16	Converted to Grams using Density of 2.16 G/ML	$201.39
63387-28-0	1,2,3,4,5-Pentabromo-6-(2,3,4,5-tetrabromophenoxy)benzene	polyhalogenated diphenyl ethers	33689-1ML	1 ML	Estimated to ship on December 22, 2021	$628.00	3.17	Converted to Grams using Density of 3.17 G/ML	$198.11
93703-48-1	BDE-77	polyhalogenated diphenyl ethers	34115-1ML	1 ML	Estimated to ship on December 22, 2021	$412.00	2.16	Converted to Grams using Density of 2.16 G/ML	$190.74
189084-62-6	2,3',4',6-Tetrabromodiphenyl Ether	polyhalogenated diphenyl ethers	34118-1ML	1 ML	Estimated to ship on December 23, 2021	$412.00	2.16	Converted to Grams using Density of 2.16 G/ML	$190.74
189084-61-5	2,3',4,4'-Tetrabromodiphenyl ether	polyhalogenated diphenyl ethers	34119-1ML	1 ML	Estimated to ship on January 06, 2022	$412.00	2.28	Converted to Grams using Density of 2.28 G/ML	$180.70

CAS Number	OFR_Chemical_Name	OFR_NAS_Category	SKU	Pack Size	Availability	Listed Price (per pack) in USD	Conversion Factor	Comp Tox Density (from Dashboard)	Price per gram in USD
189084-66-0	2,3',4,4',6-Pentabromodiphenyl Ether	polyhalogenated diphenyl ethers	34121-1ML	1 ML	Estimated to ship on February 21, 2022	$412.00	2.34	Converted to Grams using Density of 2.34 G/ML	$176.07
366791-32-4	1,2,3-Tribromo-5-(3,4-dibromophenoxy)benzene	polyhalogenated diphenyl ethers	33682-1ML	1 ML	Estimated to ship on January 07, 2022	$426.00	2.46	Converted to Grams using Density of 2.46 G/ML	$173.17
189084-64-8	2,2',4,4',6-Pentabromodiphenyl ether	polyhalogenated diphenyl ethers	33681-1ML	1 ML	Estimated to ship on December 10, 2021	$412.00	2.45	Converted to Grams using Density of 2.45 G/ML	$168.16
182346-21-0	2,2',3,4,4'-Pentabromodiphenyl ether	polyhalogenated diphenyl ethers	34114-1ML	1 ML	Estimated to ship on December 23, 2021	$412.00	2.46	Converted to Grams using Density of 2.46 G/ML	$167.48
207122-15-4	2,2',4,4',5,6'-Hexabromodiphenyl ether	polyhalogenated diphenyl ethers	33684-1ML	1 ML	Estimated to ship on December 10, 2021	$412.00	2.67	Converted to Grams using Density of 2.67 G/ML	$154.31
68631-49-2	2,2',4,4',5,5'-Hexabromodiphenyl ether	polyhalogenated diphenyl ethers	33683-1ML	1 ML	Only 1 left in stock (more on the way) - From	$412.00	2.68	Converted to Grams using Density of 2.68 G/ML	$153.73
182677-30-1	2,2',3,4,4',5'-Hexabromodiphenyl Ether	polyhalogenated diphenyl ethers	34122-1ML	1 ML	Only 2 left in stock (more on the way) - FROM	$412.00	2.68	Converted to Grams using Density of 2.68 G/ML	$153.73
189084-67-1	1,2,3,4,5-Pentabromo-6-(2,4-dibromophenoxy)benzene	polyhalogenated diphenyl ethers	33685-1ML	1 ML	Estimated to ship on December 10, 2021	$435.00	2.88	Converted to Grams using Density of 2.88 G/ML	$151.04
207122-16-5	2,2',3,4,4',5',6-Heptabromodiphenyl ether	polyhalogenated diphenyl ethers	33686-1ML	1 ML	Estimated to ship on December 10, 2021	$435.00	2.88	Converted to Grams using Density of 2.88 G/ML	$151.04
446255-56-7	PBDE 205	polyhalogenated diphenyl ethers	33688-1ML	1 ML	Estimated to ship on December 24, 2021	$435.00	3.04	Converted to Grams using Density of 3.04 G/ML	$143.09
437701-79-6	BDE-207	polyhalogenated diphenyl ethers	33617-1ML	1 ML	Estimated to ship on January 06, 2022	$412.00	3.17	Converted to Grams using Density of 3.17 G/ML	$129.97
6876-00-2	PBDE 002	polyhalogenated diphenyl ethers	728969-1G	1 G	Available to ship on December 01, 2021 - FROM	$78.50	1		$78.50

CAS Number	OFR_Chemical_Name	OFR_NAS_Category	SKU	Pack Size	Availability	Listed Price (per pack) in USD	Conversion Factor	Comp Tox Density (from Dashboard)	Price per gram in USD
1163-19-5	1,1'-Oxybis[2,3,4,5,6-pentabromobenzene]	polyhalogenated diphenyl ethers	89407-1ML	1 ML	Estimated to ship on December 10, 2021	$168.00	3.31	Converted to Grams using Density of 3.31 G/ML	$50.76
2050-47-7	4,4'-Dibromodiphenyl ether	polyhalogenated diphenyl ethers	117277-100G	100 G	Estimated to ship on December 22, 2021	$438.00	100		$4.38
101-55-3	p-Bromodiphenyl ether	polyhalogenated diphenyl ethers	B65209-100G	100 G	Estimated to ship on December 22, 2021	$292.00	100		$2.92
13674-87-8	Tris(1,3-dichloro-2-propyl) phosphate	polyhalogenated organophosphates	32951-100MG	100 MG	Available to ship on November 17, 2021 - FROM	$194.00	0.1		$1,940.00
13674-84-5	Tris(2-chloroisopropyl)phosphate	polyhalogenated organophosphates	32952-100MG	100 MG	Available to ship on November 17, 2021 - FROM	$183.00	0.1		$1,830.00
126-72-7	Tris(2,3-dibromopropyl) phosphate	polyhalogenated organophosphates	34188-100MG	100 MG	Estimated to ship on December 10, 2021	$73.50	0.1		$735.00
115-98-0	Bis(2-chloroethyl) vinylphosphonate	polyhalogenated organophosphates	S366854-250MG	250 MG	Usually ships in 2 business days. (Orders outside of US, please allow an additional 1-2 weeks for delivery)	$153.00	0.25		$612.00
115-96-8	Tris(2-chloroethyl) phosphate	polyhalogenated organophosphates	119660-25G	25 G	Available to ship on November 17, 2021 - FROM	$21.80	25		$0.87
118-79-6	2,4,6-Tribromophenol	polyhalogenated phenol derivatives	36918-250MG	250 MG	Only 1 left in stock (more on the way) - From	$51.60	0.25		$206.40
608-33-3	Phenol, 2,6-dibromo-	polyhalogenated phenol derivatives	252018-10G	10 G	Available to ship on December 01, 2021 - FROM	$161.00	10		$16.10
608-71-9	Pentabromophenol	polyhalogenated phenol derivatives	P1608-100G	100 G	Only 6 left in stock (more on the way) - From	$930.00	100		$9.30
615-58-7	2,4-Dibromophenol	polyhalogenated phenol derivatives	258164-100G	100 G	Only 4 left in stock (more on the way) - From	$134.00	100		$1.34
3555-11-1	Allyl pentabromophenyl ether	polyhalogenated phenol-aliphatic ether	S508632-250MG	250 MG	Usually ships in 2 business days. (Orders outside of US, please allow an additional 1-2 weeks for delivery)	$153.00	0.25		$612.00
607-99-8	2,4,6-Tribromoanisole	polyhalogenated phenol-aliphatic ether	398780-5G	5 G	Available to ship on November 19, 2021 - From	$60.70	5		$12.14
3278-89-5	1,3,5-Tribromo-2-(prop-2-en-1-yloxy)benzene	polyhalogenated phenol-aliphatic ether	419664-250G	250 G	Available to ship on November 19, 2021 - From	$50.60	250		$0.20

CAS Number	OFR_Chemical_Name	OFR_NAS_Category	SKU	Pack Size	Availability	Listed Price (per pack) in USD	Conversion Factor	Comp Tox Density (from Dashboard)	Price per gram in USD
632-79-1	4,5,6,7-Tetrabromo-1,3-Isobenzofurandione	polyhalogenated phthalates/benzoates/imides	8080960250	250 G	Estimated to ship on December 06, 2021	$62.30	250		$0.25
117-08-8	Tetrachlorophthalic anhydride	polyhalogenated phthalates/benzoates/imides	131865-500G	500 G	Available to ship on November 19, 2021 - From	$95.00	500		$0.19
52434-90-9	1,3,5-Tris(2,3-dibromopropyl)-1,3,5-triazine-2,4,6(1H,3H,5H)-trione	polyhalogenated triazines	269999-500G	500 G	Only 1 left in stock (more on the way) - From	$208.00	500		$0.42
Data were collected from the internet in November and December, 2021. Data were unavailable for the remaining compounds.									