



Use and Market Profile for Carbon Tetrachloride

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Table of Contents

1.	Introduction	1
1.1	Overview of Carbon Tetrachloride	1
1.2	Historical Use of Carbon Tetrachloride	1
1.3	Existing Regulations	3
1.4	Montreal Protocol	4
2.	Production and Producers	5
2.1	Current U.S. Production Volume	5
2.2	Historical U.S. Production Volume	5
2.3	U.S. Facility and Company-Level Production Data.....	5
2.3.1	Chemical Data Reporting	5
2.3.2	Toxics Release Inventory	6
2.3.3	Other Facilities That May Produce Carbon Tetrachloride	7
3.	Use Information and Market Trends.....	9
3.1	Historical Use.....	9
3.2	Use Information from 2012 CDR	10
4.	Toxic Release Inventory	14
5.	National Emissions Inventory.....	22
6.	References	24
	Appendix 1: Reported Activities and Uses on TRI Form R.....	25

List of Tables and Appendices

Table 1: Chemical Name, Synonyms, and CASRN.....	1
Table 2: Federal Regulations and Guidelines Concerning Carbon Tetrachloride	3
Table 3: U.S. Production of Carbon Tetrachloride (million lb).....	Error! Bookmark not defined.
Table 4: National Production Volume Data for Carbon Tetrachloride from 1986-2012 (pounds).....	5
Table 6: 2012 CDR Production Volume Data for Carbon Tetrachloride (Pounds)	6
Table 7: 2014 Select TRI Manufacturers and Importers of Carbon Tetrachloride	7
Table 8: 2012 CDR Use and Production Data for Carbon Tetrachloride	11
Table 9: Facilities Manufacturing Carbon Tetrachloride Derivatives (2012 CDR).....	13
Table 11: Summary of 2014 TRI Activity or Use by Number of Facilities for Carbon Tetrachloride.....	15
Table 12: Summary of 2014 NAICS Codes Associated with Carbon Tetrachloride.....	15
Table 13: Detailed 2014 TRI Activity or Use for Carbon Tetrachloride by Facility.....	17
Table 14: Summary of 2014 NEI Carbon Tetrachloride Emissions Including Top Industry Sectors and Facilities	22

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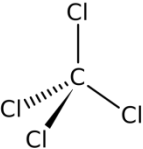
1. Introduction

Carbon tetrachloride is the subject of this use and market profile. This report provides an overview (Section 1), U.S. producers, production, and import volume (Section 2), use information and market trends (Section 3), and Toxic Release Inventory data (Section 4) for this chemical.

1.1 Overview of Carbon Tetrachloride

Carbon tetrachloride (CCl₄) is a colorless, sweet-smelling organic compound that is primarily used as a feedstock to manufacture hydrofluorocarbon (HFC) and hydrofluoroolefin (HFO) refrigerants, including HFC-245fa, HFC-365mfc (UNEP, 2016a) and HFO-1234yf/ze (IHS Chemical, 2016a). Carbon tetrachloride has minor laboratory, petroleum refining, and pharmaceutical manufacturing applications (NTP, 2016). Key identification details of carbon tetrachloride are listed in Table 1.

Table 1: Chemical Name, Synonyms, and CASRN

CAS RN	56-23-5
Synonyms	Benziform, Carbon chloride, Carbon tet, Methane tetrachloride, Methane, tetrachloro-, Methyl tetrachloride, Perchloromethane, Tetrachloromethane (IUPAC)
Molecular Formula	CCl ₄
Structure	
Trade Names	Benzinoform, Carbona, Fasciolin, Flukoids, Freon 10, Halon 1040, Necotorina, Necatorine, R 10 (refrigerant), Tetrafinol, Tetraform, Tetrasol, Univerm, Vermoestricid
Source:	NLM (n.d.)

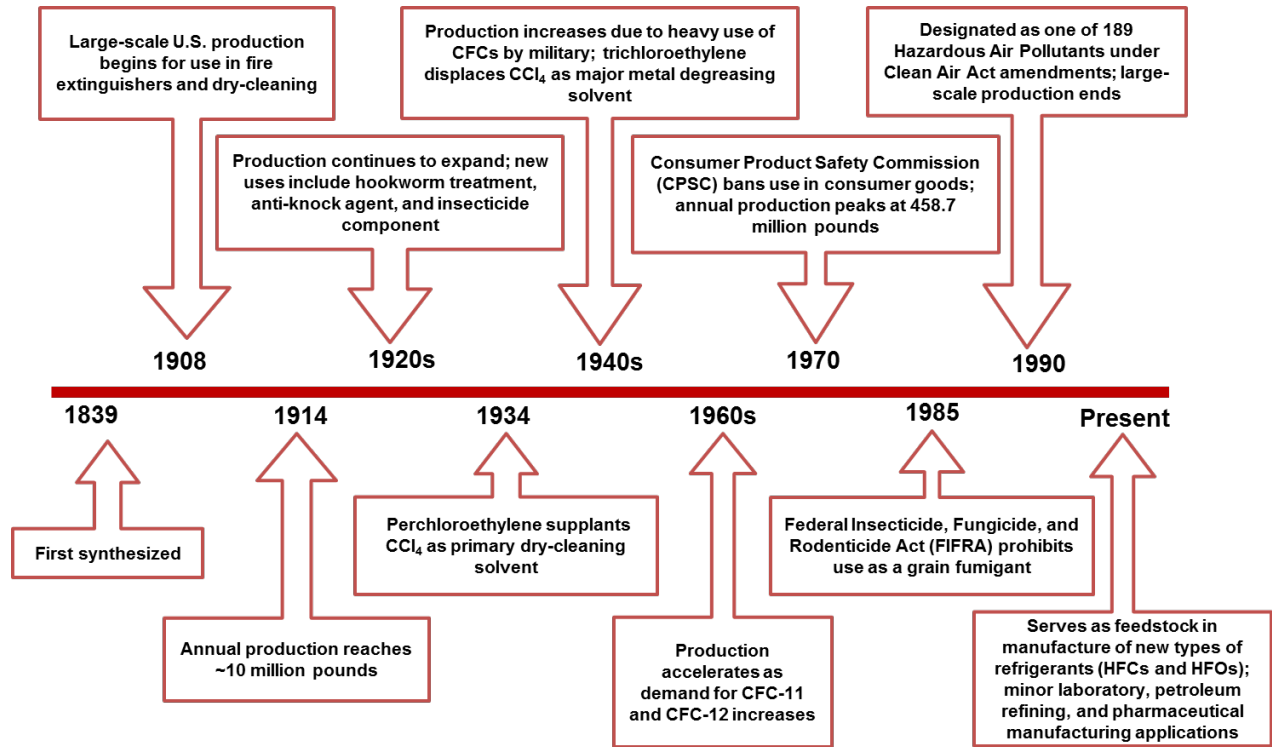
1.2 Historical Use of Carbon Tetrachloride

Carbon tetrachloride was first synthesized in 1839 by the French chemist Henri Victor Regnault in the reaction of chloroform with chlorine in sunlight. Large scale production in the U.S. began by Warner Chemical and Dow Chemical in 1908. Its first major industrial or commercial uses were as a fire extinguisher fluid and dry-cleaning solvent. Carbon tetrachloride served as a metal degreaser and solvent in the production of rubber as well (Doherty, 2000; Holbrook, 2000).

In the 1950s, the most important use of carbon tetrachloride became as a feedstock in the production of chlorofluorocarbon (CFC) refrigerants (Doherty, 2000). Other historical uses included as a grain fumigant, anti-knock agent in gasoline, hookworm treatment, anesthetic, insecticide component, and industrial solvent (Hall, 1921; Hardin, 1954; Daft, 1991; Doherty, 2000). Due to its potential to cause adverse health effects, carbon tetrachloride and mixtures containing it were banned from consumer products by the Consumer Product Safety Commission (CPSC) in 1970 (Holbrook, 2000). Production of carbon tetrachloride continued to decline with the implementation of the Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol) through the 1990 Clean Air Act amendments, which banned carbon tetrachloride's emissive uses and phased out CFCs for all but explicitly permitted uses

(Doherty, 2000). Figure 1 summarizes key events associated with carbon tetrachloride and its uses over time.

Figure 1: Carbon Tetrachloride Timeline



Source: Doherty (2000); Holbrook (2000)

1.3 Existing Regulations on Carbon Tetrachloride

Many U.S. Federal agencies have issued regulations or guidelines concerning carbon tetrachloride. Table 2 summarizes these regulations as of 2016.

Table 2: Federal Regulations and Guidelines Concerning Carbon Tetrachloride

Agency or Regulation	Description of Regulation or Guideline
Coast Guard, Department of Homeland Security	Minimum requirements have been established for safe transport of carbon tetrachloride on ships and barges.
Consumer Product Safety Commission (CPSC)	Carbon tetrachloride and mixtures containing it (with the exception of chemicals containing unavoidable residues of carbon tetrachloride that do not result in atmospheric concentrations of carbon tetrachloride greater than 10 ppm) are banned from consumer products.
Department of Transportation (DOT)	Carbon tetrachloride is considered a hazardous material and marine pollutant, and special requirements have been set for marking, labeling, and transporting this material.
Clean Air Act (EPA)	<i>National Emission Standards for Hazardous Air Pollutants:</i> Listed as a hazardous air pollutant. <i>New Source Performance Standards:</i> Manufacture of carbon tetrachloride is subject to certain provisions for the control of volatile organic compound emissions. <i>Urban Air Toxics Strategy:</i> Identified as one of 33 hazardous air pollutants that present the greatest threat to public health in urban areas. Carbon tetrachloride is regulated as a Class I substance for stratospheric ozone protection.
Clean Water Act (EPA)	<i>Effluent Guidelines:</i> Listed as a toxic pollutant. <i>Water Quality Criteria:</i> Based on fish or shellfish and water consumption = 0.4 µg/L; based on fish or shellfish consumption only = 5 µg/L. Designated a hazardous substance.
Comprehensive Environmental Response, Compensation, and Liability Act (EPA)	Reportable quantity (RQ) = 10 lb.
Emergency Planning and Community Right-To-Know Act (EPA)	<i>Toxics Release Inventory:</i> Listed substance subject to reporting requirements.
Federal Insecticide, Fungicide, and Rodenticide Act	All registrations for use as a pesticide have been cancelled.
Resource Conservation and Recovery Act (EPA)	<i>Characteristic Hazardous Waste:</i> Toxicity characteristic leaching procedure (TCLP) threshold = 0.5 mg/L. <i>Listed Hazardous Waste:</i> : Waste codes for which the listing is based wholly or partly on the presence of carbon tetrachloride = U211, F001, F024, F025, K016, K019, K020, K021, K073, K116, K150, K151, K157. Listed as a hazardous constituent of waste.
Safe Drinking Water Act (EPA)	Maximum contaminant level (MCL) = 0.005 mg/L.

Agency or Regulation	Description of Regulation or Guideline
Food and Drug Administration (FDA)	Maximum permissible level in bottled water = 0.005 mg/L. All medical devices containing or manufactured with carbon tetrachloride must contain a warning statement that the compound may destroy ozone in the atmosphere.
Mine Safety and Health Administration	Carbon tetrachloride use is banned in metal and non-metal surface and underground mines.
Occupational Safety and Health Administration (OSHA)	While this section accurately identifies OSHA's legally enforceable PELs for this substance in 2010, specific PELs may not reflect the more current studies and may not adequately protect workers. Permissible exposure limit (PEL) = 10 ppm. Ceiling concentration = 25 ppm. Acceptable peak exposure = 200 ppm (maximum duration = 5 min in any 4 h). Carbon tetrachloride cannot be used as a fire extinguishing agent where employees may be exposed.
American Conference of Governmental Industrial Hygienists (ACGIH)	Threshold limit value – time-weighted average (TLV-TWA) = 5 ppm. Threshold limit value – short-term exposure limit (TLV-STEL) = 10 ppm. Potential for dermal absorption.
National Institute for Occupational Safety and Health (NIOSH)	Short-term exposure limit (STEL) = 2 ppm (12.6 mg/m ³) (60-min exposure). Immediately dangerous to life and health (IDLH) limit = 200 ppm. Listed as a potential occupational carcinogen.
Source: NTP (2016)	

1.4 Montreal Protocol

Carbon tetrachloride is also regulated under the Montreal Protocol because of its classification as an ozone-depleting substance (ODS). Enacted in 1987, this international treaty aims to protect the ozone layer by phasing out ODS. Member countries, including the U.S., were required to have a 100 percent reduction in the production and consumption of carbon tetrachloride by January 1, 1996, with possible exemptions (UNEP, 2016b). Exemptions may include use as a feedstock, used substances (recovered and reclaimed), essential uses, and others listed in the *Handbook on Data Reporting under the Montreal Protocol* (1999).

2. Production and Producers

This section examines current and historical U.S. production volume of carbon tetrachloride and facility level data for manufacturers of carbon tetrachloride.

2.1 U.S. Production Volume

In the U.S., large-scale production of carbon tetrachloride began in 1908 (Doherty, 2000). By 1914, almost 10 million pounds were being produced annually (Doherty, 2000). Production is reported to have peaked in 1970 at 458.7 million pounds (Holbrook, 2000).

The subsections below provide historical and recent U.S. Production volume from publically available data from the 1986-2006 Inventory Update Reporting (IUR) rule and the 2012 Chemical Data Reportign (CDR) (reflecting 2011 production data).

2.1.1 IUR and CDR

Table 3 presents the historic U.S. production volume data for carbon tetrachloride submitted by companies under the non-confidential 1986, 1990, 1994, 1998, 2002, and 2006 Inventory Update Reporting (IUR) rule and the 2012 CDR (reflecting 2011 production data). While the reporting threshold for manufacturing information was 25,000 pounds for the 2006 IUR and 2012 CDR, the reporting threshold for manufacturing information was 10,000 pounds from 1986 to 2002.

Table 3: CDR U.S. Production Volume Data for Carbon Tetrachloride from 1986-2012 (lb)

1986	1990	1994	1998	2002	2006	2011
>500M – 1B	>500M – 1B	>100M – 500M	>100M – 500M	>100M – 500M	100M- <500M	149,927,241
Source: U.S. EPA (n.d.); U.S. EPA (2010); U.S. EPA (2014a)						

2.2 U.S. Import and Export Data

Imports of carbon tetrachloride fell from 242 million pounds in 1989 to 0 in 1996. On the export side, U.S. exports decreased from 116 million pounds in 1989 to 3.8 million pounds in 2008 (NTP, 2016).

Specific companies identified as importers of carbon tetrachloride include Dow Chemical Co, Enterprise Products (U.S. EPA, 2014b), and INEOS USA (U.S. EPA, 2014a).

2.3 U.S. Facility and Company-Level Production Data

2.3.1 Chemical Data Reporting

U.S. production volume data for carbon tetrachloride reported in the 2012 CDR is presented in Table 6 by producer for the years 2011 and 2010 (past). For the 2012 CDR, represented by the year 2011, nine facilities reported production volumes of carbon tetrachloride, three of which withheld their facility identity as confidential business information (CBI). Note that other sites may manufacture or import carbon tetrachloride but are not listed in the public CDR database because they claimed their production as CBI. Other sites might not be listed due to having had production volumes below the 25,000 lb annual

reporting threshold. CDR also provides exemption due to manufacturing carbon tetrachloride as an impurity with no commercial purpose and for non-isolated intermediates.

Table 4: 2012 CDR Production Volume Data for Carbon Tetrachloride (Pounds)

Company	Location	Manufactured Volume	Imported Volume	Past Production Volume (2010)
INEOS USA, LLC	Wilmington, DE	0	763,400	92,400
Shin-Etsu	Plaquemine, LA	2,480,599	0	1,293,461
Syngenta Corp	Saint Gabriel, LA*	CBI	0	CBI
The Dow Chemical Co	Freeport, TX*	CBI	0	CBI
The Dow Chemical Co	Pittsburg, CA*	CBI	0	CBI
The Dow Chemical Co	Plaquemine, LA*	CBI	0	CBI
CBI	CBI	CBI	CBI	CBI
CBI	CBI	CBI	CBI	CBI
CBI	CBI	CBI	CBI	CBI

CBI = confidential business information
 * = reported to import or manufacture carbon tetrachloride to TRI in RY2014
Source: U.S. EPA (2014a)

2.3.2 Toxics Release Inventory

In total, 27 U.S. facilities reported manufacturing or importing carbon tetrachloride to the TRI for Reporting Year (RY) 2014. A full list of all TRI reporters is provided in Table 13. Like CDR, TRI facilities must report manufacture of carbon tetrachloride above 25,000 lb per year (along with release and waste management data); however, TRI does not have an exemption for manufacture as an impurity or non-isolated intermediate.

A select list of TRI facilities that report producing or importing carbon tetrachloride is given in Table 7. These facilities are either matched to a CDR facility reporting carbon tetrachloride (in italics) or indicate a deliberate use on-site of carbon tetrachloride. These deliberate uses include:

- Processing as a reactant;
- Processing as a formulation component;
- Processing as repackaging for further distribution;
- On-site use as a chemical processing aid; or
- On-site use as a manufacturing aid.

Table 5: 2014 Select TRI Manufacturers and Importers of Carbon Tetrachloride
(Facilities in italics are matched to 2012 CDR reporting for carbon tetrachloride)

Facility ¹	Maximum Amount On-Site (lb)	Manufacturing Activities	Processing and Otherwise Use
Occidental Chemical Holding Corp - Geismar Plant Occidental Chemical Holding Corp Geismar, LA 70734	50,000,000- 99,999,999	Produce, Used Processed, Sale Distribution, Byproduct	Reactant, Manufacture Aid
<i>Dow Chemical Co The Dow Chemical Co Pittsburg, CA 94565</i>	<i>10,000,000- 49,999,999</i>	<i>Produce, Used Processed, Byproduct</i>	<i>Reactant, Chemical Processing Aid, Manufacture Aid</i>
Occidental Chemical Corp Occidental Chemical Holding Corp Wichita, KS 67215	1,000,000- 9,999,999	Produce, Used Processed, Sale Distribution	Repackaging, Ancillary
<i>The Dow Chemical Co - Louisiana Operations The Dow Chemical Co Plaquemine, LA 70764</i>	<i>1,000,000- 9,999,999</i>	<i>Produce, Used Processed, Sale Distribution, Byproduct, Manufacture Impurity</i>	<i>Reactant, Chemical Processing Aid, Ancillary</i>
Westlake Vinyls Inc Westlake Chemical Corp Calvert City, KY 42029	1,000,000- 9,999,999	Produce, Used Processed	Reactant, Ancillary
<i>Dow Chemical Co Freeport Facility The Dow Chemical Co Freeport, TX 77541</i>	<i>1,000,000- 9,999,999</i>	<i>Produce, Imported, Byproduct, Manufacture Impurity</i>	<i>Reactant, Process Impurity, Chemical Processing Aid, Ancillary</i>
Enterprise Products Operating LLC Enterprise Products Operating LLC Mont Belvieu, TX 77580	100,000- 999,999	Imported, Used Processed	Chemical Processing Aid
Formosa Plastics Corp Texas Formosa Plastics Corp USA Point Comfort, TX 77978	100,000- 999,999	Produce, Used Processed, Manufacture Impurity	Formulation Component, Process Impurity
<i>Syngenta Crop Protection LLC Saint Gabriel Facility Syngenta Corp Saint Gabriel, LA 70776</i>	<i>100,000- 999,999</i>	<i>Produce, Byproduct</i>	<i>Chemical Processing Aid</i>
Dover Chemical Corp ICC Industries Inc Dover, OH 44622	100,000- 999,999	Produce, Manufacture Impurity	Manufacture Aid
Oxy Vinyls LP La Porte VCM Plant Occidental Chemical Holding Corp La Porte, TX 77571	10,000- 99,999	Produce, Byproduct	Reactant, Manufacture Aid
Westlake Vinyls Co Westlake Chemical Corp Geismar, LA 70734	1,000- 9,999	Produce, Sale Distribution, Byproduct, Manufacture Impurity	

2.3.3 Other Facilities That May Produce Carbon Tetrachloride

While facilities are able to claim CBI to withhold their identity for public releases of CDR data, other publicly available resources may be used to identify facilities that deliberately manufacture and use or sell

chemicals. For example, such a facility may be identified using TRI data if they have reported significant maximum amounts of on-site quantities and/or deliberate uses including:

- manufacture for sale or distribution;
- processing as a reactant; or
- repackaging for distribution into commerce.

Company publications, such as sustainability reports, safety data sheets (SDS), and product details, may also indicate manufacture or sale of a chemical. This section explores other facilities that are not identified through the public CDR data..

Occidental Chemical Holding Corp

Three facilities owned by Occidental Chemical Holding reported manufacturing carbon tetrachloride to TRI in 2014 but were not matched to any 2012 CDR facilities publicly reporting carbon tetrachloride:

- Occidental Chemical Holding Corp - Geismar Plant; Geismar, LA 70734
 - Maximum amount on-site: 50,000,000 - 99,999,999 lb
 - Produce, Used Processed, Sale Distribution, Byproduct, Reactant, Manufacture Aid
- Occidental Chemical Corp; Wichita, KS 67215
 - Maximum amount on-site: 1,000,000 - 9,999,999 lb
 - Produce, Used Processed, Sale Distribution, Repackaging, Ancillary
- Oxy Vinyls LP La Porte VCM Plant; La Porte, TX 77571
 - Maximum amount on-site: 10,000 - 99,999 lb
 - Produce, Byproduct, Reactant, Manufacture Aid

Company publications strongly support that Occidental Chemical Holding Corp is a primary producer and supplier of carbon tetrachloride.

- “OxyChem produces one grade of carbon tetrachloride as Technical Grade manufactured at both Wichita, KS and Geismar, LA facilities”(OxyChem, 2014).
- “OxyChem manufactures carbon tetrachloride at facilities in Geismar, Louisiana and Wichita, Kansas” (OxyChem, 2013).

Based on TRI and company publications, the Geismar Plant and Wichita facility appear to be primary manufacturers of carbon tetrachloride.

Formosa Plastics Corp USA

One facility owned by Formosa Plastics Corp USA reported manufacturing carbon tetrachloride in 2012 but was not matched a 2012 CDR facility publicly reporting carbon tetrachloride:

- Formosa Plastics Corp Texas; Point Comfort, TX 77978
 - Maximum amount on-site: 100,000 - 999,999 lb
 - Produce, Used Processed, Manufacture Impurity, Formulation Component, Process Impurity

An MSDS for ‘light ends, wet’ indicates that carbon tetrachloride is present at a 10-20% concentration in a mixture manufactured by this facility (Formosa Plastics Corporation, 2007).

Westlake Chemical Corp

Two facilities owned by Westlake Chemical Corp reported manufacturing carbon tetrachloride to TRI in 2014, but were not matched to any 2012 CDR facilities reporting carbon tetrachloride:

- Westlake Vinyls Inc; Calvert City, KY 42029
 - Maximum amount on-site: 1,000,000- 9,999,999
 - Produce, Used Processed, Reactant, Ancillary
- Westlake Vinyls Co; Geismar, LA 70734
 - Maximum amount on-site: 1,000 - 9,999
 - Produce, Sale Distribution, Byproduct, Manufacture Impurity

An MSDS describes an EDC (ethylene dichloride) intermediate feedstock that contains 2-50% carbon tetrachloride (Westlake Chemical, 2015). TRI reporting indicates that carbon tetrachloride is produced for sale and distribution by the Geismar facility; however, no secondary sources confirm that Westlake Chemical Corp supplies carbon tetrachloride. Thus, it is possible that one or both of the Westlake Chemical Corp facilities are listed as CBI in 2012 CDR.

ICC Industries/Dover Chemical Corp

One facility owned by ICC Industries reported manufacturing carbon tetrachloride in 2012 but was not matched to a 2012 CDR facility publicly reporting carbon tetrachloride:

- Dover Chemical Corp; Dover, OH 44622
 - Maximum amount on-site: 100,000- 999,999
 - Produce, Manufacture Impurity Manufacture Aid

In 2014, the Dover Chemical Corp plant released “heavy chlorinated wax material that contains carbon tetrachloride as a byproduct” (Mizer, 2014). Further, a National Pollutant Discharge Elimination System (NPDES) permit for the facility allows for loading of carbon tetrachloride (Ohio EPA, 2015). Given that the facility reports use as a manufacturing aid, it is unlikely that ICC Industries supplies carbon tetrachloride.

3. Use Information and Market Trends

The primary use of carbon tetrachloride is as a chemical feedstock for the production of chlorinated and fluorinated compounds. Other minor known uses include use as an industrial solvent and in pharmaceutical manufacturing, agrochemical processes, petroleum refining, laboratory applications, and fats, oils, and rubber processing (OxyChem, 2013; NTP, 2016).

3.1 Historical Use

In the 1950s, the percentage use of carbon tetrachloride by sector was as follows: CFC production (50%), metal cleaning (15%), grain fumigation (7%), dry-cleaning (5%), and other uses (23%). CFC production took over more of the market once the use of carbon tetrachloride in consumer products and grain fumigants was banned. By the 1990s, CFC production accounted for 98% of the total demand of carbon tetrachloride (Doherty, 2000).

With the enactment of the Montreal Protocol, production and consumption of carbon tetrachloride were expected to be virtually eliminated. However, carbon tetrachloride is now being used as a feedstock to

make new types of refrigerants that do not deplete the ozone layer, such as HFC-245fa, HFC-365mfc, and HFO-1234y. As previously mentioned, the use of ODS as a feedstock may be permitted under the Montreal Protocol, assuming the ODS are totally transformed in the process. In 2014, carbon tetrachloride made up 18.3% of ozone-depleting substances used as feedstock by countries that are part of the Montreal Protocol (UNEP, 2016a).

3.2 Use Information from 2012 CDR

Table 8 shows the industrial uses of carbon tetrachloride from 2012 CDR data (U.S. EPA, 2014a). Types of processing and industrial uses include:

- Processing as a reactant:
 - Intermediates
 - Process regulators
- Use-non-incorporative activities:
 - Processing aids, not otherwise listed
 - Not known or reasonably ascertainable
 - Laboratory chemicals

Reported sectors processing or using carbon tetrachloride include:

- All Other Basic Organic Chemical Manufacturing;
- All Other Chemical Product and Preparation Manufacturing; and
- Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing.

No consumer uses are listed in the CDR, in line with the prohibition of carbon tetrachloride in products intended for home use (HSDB, 2014).

Table 6: 2012 CDR Use and Production Data for Carbon Tetrachloride

Manufacturing Site	Type of Processing	Industrial Use Data		
		Sector	Industrial Use	Percent of Production Volume
Dow Chemical Co Freeport Facility The Dow Chemical Co 2301 N Brazosport Blvd Freeport, TX 77541	Use-non-incorporative activities	All Other Basic Organic Chemical Manufacturing	Processing aids, not otherwise listed	1
	Processing as a reactant	All Other Basic Organic Chemical Manufacturing	Intermediates	100
Dow Chemical Co The Dow Chemical Co 901 Loveridge Rd Pittsburg, CA 94565	Processing as a reactant	All Other Basic Organic Chemical Manufacturing	Intermediates	100
The Dow Chemical Co - Louisiana Operations The Dow Chemical Co 21255 La Hwy 1 S Plaquemine, LA 70764	Use-non-incorporative activities	All Other Basic Organic Chemical Manufacturing	Processing aids, not otherwise listed	100
INEOS USA, LLC 2036 Foulk Rd Suite 204 Wilmington, DE 19810	Processing as a reactant	All Other Chemical Product and Preparation Manufacturing	Intermediates	100
Shin-Etsu 26270 Highway 405, River Rd South Plaquemine, LA 70764	Use-non-incorporative activities	All Other Chemical Product and Preparation Manufacturing	Not known or reasonably ascertainable	100
Syngenta Crop Protection LLC Saint Gabriel Facility Syngenta Corp 3905 Hwy 75 Saint Gabriel, LA 70776	Use-non-incorporative activities	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Processing aids, not otherwise listed	100
CBI	Processing as a reactant	CBI	Intermediates	CBI
CBI	Processing as a reactant	All Other Basic Organic Chemical Manufacturing	Intermediates	100
CBI	Use-non-incorporative activities	CBI	Laboratory chemicals	CBI
		CBI	Process regulators	CBI
	Processing as a reactant	CBI	Intermediates	CBI
Source: U.S. EPA (2014a)				

3.3 Use as Feedstock

3.3.1 Derivatives Manufactured

The primary use of carbon tetrachloride is as a feedstock in the production of fluorinated compounds. Approximately 98% of carbon tetrachloride was used for CFCs production in the 1990s (Doherty, 2000) but it is now primarily used for the production of HFCs (IHS Chemical, 2016a). No evidence was found to suggest that more than 2% is currently being used for non-reactant uses.

Carbon tetrachloride may be used as a feedstock for making the following derivative chemicals. Note that alternate reaction pathways may be available for some, if not all, of these chemicals.

- HFC-245fa (1,1,1,3,3-pentafluoropropane, CAS: 460-73-1) (UNEP, 2016a);
- HFC-365mfc (1,1,1,3,3-pentafluorobutane, CAS: 406-58-6) (UNEP, 2016a);
- HFC-236fa (1,1,1,3,3,3-hexafluoropropane, CAS: 690-39-1) (UNEP, 2016a);
- HFO-1234yf (2,3,3,3-tetrafluoro-1-propene, CAS: 754-12-1) (IHS Chemical, 2016a);
- HFO-1234ze ((1E)-1,3,3,3-tetrafluoro-1-propene, CAS: 29118-24-9) (IHS Chemical, 2016a); and
- Perchloroethylene (Tetrachloroethene, CAS: 127-18-4) (UNEP, 2016a).

Although CFC-11 and CFC-12 were also identified as directly manufactured from carbon tetrachloride, they are now only manufactured in China for use as aerosol in metered dose inhalers. HFC and HFO derivatives are primarily used as refrigerants or foam propellants (IHS Chemical, 2016a).

3.3.2 Facilities Manufacturing Derivatives

All U.S. facilities reporting manufacture of known carbon tetrachloride derivatives are listed in Table 9. Numerous reaction routes are possible for some if not all chemicals above, so not all facilities manufacturing these chemicals will necessarily use carbon tetrachloride as a feedstock. Processing as a reactant was reported by seven TRI facilities (see Table 11) for RY2014; however, only three facilities of these seven facilities are identified in Table 9.

Table 7: Facilities Manufacturing Carbon Tetrachloride Derivatives (2012 CDR)

Company	Location	Manufactured Volume (lb)	Imported Volume
HFC-245a (CAS: 460-73-1)			
Honeywell International Inc	Geismar, LA	45,395,380	0
Rubicon	Geismar, LA	0	CBI
HFC-365mfc (CAS:406-58-6)			
Solvay America Inc	Houston, TX	CBI	CBI
HFO-1234yf (CAS: 754-12-1)			
Honeywell International Inc	Buffalo, NY	97,680	0
Honeywell International Inc	Danville, IL	0	29,080
HFC-236fa (CAS: 690-39-1)			
E I Du Pont De Nemours & Co	Wilmington, DE	0	CBI
HFO-1234ze (CAS: 29118-24-9)			
Honeywell International Inc	Buffalo, NY	1,726,730	0
Perchloroethylene (CAS: 127-18-4)			
Solvchem Inc	Pearland, TX	508,284	0
Shin Etsu	Plaquemine, LA	339,297	0
Trinternational Inc	Seattle, WA	0	29,100
Lord Corp	CBI	CBI	CBI
PPG Industries Inc	Lake Charles, LA	CBI	0
The Dow Chemical Co	Freeport, TX*	CBI	0
The Dow Chemical Co	Midland, MI*	0	CBI
The Dow Chemical Co	Plaquemine, LA*	CBI	0
CBI	CBI	CBI	CBI
CBI	CBI	CBI	CBI
CBI	CBI	CBI	CBI

* Facilities reporting 'processing as a reactant' for carbon tetrachloride activities to TRI in RY2014.

3.4 Other Uses

Carbon tetrachloride has limited other uses for which little information is available. Carbon tetrachloride is believed to be used as a solvent or processing aid. Use as a chemical or mechanical processing aid was reported by TRI facilities in the following sectors (see Table 12 and Table 13 for detailed information):

- Natural Gas Liquid Extraction (NAICS 211112)
- All Other Basic Organic Chemical Manufacturing (NAICS 325199)
- Pesticide and Other Agricultural Chemical Manufacturing (NAICS 325320)
- All Other Miscellaneous Chemical Product and Preparation Manufacturing (NAICS 325998)

Use as an article component was reported by one facility in Hazardous Waste Treatment and Disposal (NAICS 562211). Given the reporting facility disposes of hazardous waste, the reported activity likely is related to its waste treatment or disposal rather than indicating a deliberate use of carbon tetrachloride.

Use as a formulation component was reported by one facility in Plastics Material and Resin Manufacturing (NAICS 325211). However, the facility also indicated it was manufactured and processed as an impurity, so this use does not appear deliberate.

Small amounts of carbon tetrachloride are used in laboratory and analytical settings. Members of the Montreal Protocol voted to allow the production and consumption of carbon tetrachloride for these purposes in 1997 (Nordic Council of Ministers, 2003; U.S. EPA, 2016).

4. Toxic Release Inventory

Facilities manufacturing, processing, or otherwise using carbon tetrachloride are required to report releases to EPA's Toxic Release Inventory (TRI). For Reporting Year (RY) 2014, 41 facilities reported carbon tetrachloride, 40 using TRI Form R and 1 using TRI Form A¹.

A summary of the RY 2014 on-site activities and uses reported for carbon tetrachloride on TRI Form Rs is provided in Table 11. These data describe the manufacturing, processing, and otherwise use activities occurring at a facility with the chemical. Waste management quantities of carbon tetrachloride in RY2014 totaled 25.3 million lb (U.S. EPA, 2014b), including:

- 131,424 lb released to the environment;
- 4,057,035 lb used for energy recovery;
- 5,106,905 lb recycled; and
- 16,063,528 lb treated for destruction.

Appendix 1: Reported Activities and Uses on TRI Form R provides detail on the information reported on this section.

A summary of facilities reporting carbon tetrachloride by NAICS sector and their on-site activities and uses is provided in Table 12. Carbon tetrachloride was reported by 17 unique NAICS sectors, with the most common being All Other Basic Organic Chemical Manufacturing (325199) and Hazardous Waste Treatment and Disposal (562211) with nine facilities reporting in each sector.

Table 13 lists each RY 2014 TRI facility reporting carbon tetrachloride, the maximum amount of the chemical present at the facility per year, and the reported on-site activities and uses of carbon tetrachloride. The 'Facility' column is hyperlinked the corresponding RY 2014 report.

¹ The TRI Form R is the standard TRI reporting form that includes full details about releases, waste management, and on-site activities and uses. The TRI Form A is a shorted certification statement where reporters certify that total waste management including releases did not exceed 500 lb and does not include the same release, waste management or on-site activities and uses data.

Table 8: Summary of 2014 TRI Activity or Use by Number of Facilities for Carbon Tetrachloride

Activity	Category	Number of Facilities Reporting
Manufacture	Produce	26
	Imported	2
	Used Processed	8
	Sale Distribution	4
	Byproduct	18
	Manufacture Impurity	9
Process	Reactant	7
	Article Component	1
	Formulation Component	1
	Repackaging	2
	Process Impurity	3
Otherwise Use	Chemical Processing Aid	5
	Manufacture Aid	4
	Ancillary	18
Source: U.S. EPA (2014b)		

Table 9: Summary of 2014 NAICS Codes Associated with Carbon Tetrachloride

NAICS Code	NAICS Description	Number of TRI Facilities	Facilities Reporting On-Site Activities
211112	Natural Gas Liquid Extraction	1	Imported: 1 Used Processed: 1 Chemical Processing Aid: 1
212393	Other Chemical and Fertilizer Mineral Mining	1	Produce: 1 Manufacture Impurity: 1
321219	Reconstituted Wood Product Manufacturing	1	Produce: 1 Byproduct: 1
325110	Petrochemical Manufacturing	1	Produce: 1 Used Processed: 1 Byproduct: 1
325120	Industrial Gas Manufacturing	1	Reactant: 1

NAICS Code	NAICS Description	Number of TRI Facilities	Facilities Reporting On-Site Activities
325180	Other Basic Inorganic Chemical Manufacturing	2	Produce: 2 Used Processed: 1 Sale Distribution: 1 Byproduct: 1 Repackaging: 1 Ancillary: 1
325194	Cyclic Crude, Intermediate, and Gum and Wood Chemical Manufacturing	1	Produce: 1 Byproduct: 1
325199	All Other Basic Organic Chemical Manufacturing	9	Produce: 9 Imported: 1 Used Processed: 3 Sale Distribution: 2 Byproduct: 8 Manufacture Impurity: 2 Reactant: 5 Process Impurity: 1 Chemical Processing Aid: 2 Manufacture Aid: 2 Ancillary: 5
325211	Plastics Material and Resin Manufacturing	6	Produce: 6 Used Processed: 1 Sale Distribution: 1 Byproduct: 3 Manufacture Impurity: 4 Formulation Component: 1 Process Impurity: 2 Ancillary: 1
325320	Pesticide and Other Agricultural Chemical Manufacturing	3	Produce: 3 Used Processed: 1 Byproduct: 2 Manufacture Impurity: 1 Reactant: 1 Chemical Processing Aid: 2 Manufacture Aid: 1
325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing	1	Produce: 1 Manufacture Impurity: 1 Manufacture Aid: 1
327310	Cement Manufacturing	1	Ancillary: 1
327992	Ground or Treated Mineral and Earth Manufacturing	1	Ancillary: 1
331410	Nonferrous Metal (except Aluminum) Smelting and Refining	1	Produce: 1 Byproduct: 1
424690	Other Chemical and Allied Products Merchant Wholesalers	1	<i>Not Reported (Form A)</i>

NAICS Code	NAICS Description	Number of TRI Facilities	Facilities Reporting On-Site Activities
562211	Hazardous Waste Treatment and Disposal	9	Article Component: 1 Repackaging: 1 Ancillary: 8
562213	Solid Waste Combustors and Incinerators	1	Ancillary: 1

Source: U.S. EPA (2014b); NAICS Association (2016)

Table 10: Detailed 2014 TRI Activity or Use for Carbon Tetrachloride by Facility

Facility ¹	Maximum Amount On-Site (lb)	Activity or Use
Axiall LLC Axiall Corp 26100 Hwy 405 S Plaquemine, LA 70764 325211 Plastics Material and Resin Manufacturing	100,000 - 999,999	Produce, Byproduct
Eagle Us 2 LLC Axiall Corp 1300 PPG Dr Westlake, LA 70669 325180 Other Basic Inorganic Chemical Manufacturing	100,000 - 999,999	Produce, Byproduct
Georgia Gulf Lake Charles LLC Axiall Corp 1600 VCM Plant Rd Westlake, LA 70669 325110 Petrochemical Manufacturing	10,000 - 99,999	Produce, Used Processed, Byproduct
BASF Corp BASF Corp 8404 Hwy 75 Geismar, LA 70734 325199 All Other Basic Organic Chemical Manufacturing	1,000 - 9,999	Produce, Byproduct
Chemical Solvents Inc--Denison Facility Chemical Solvents Inc 1010 Old Denison Ave Cleveland, OH 44109 562211 Hazardous Waste Treatment and Disposal	10,000 - 99,999	Ancillary
Chemtron Corp 35850 Schneider Ct Avon, OH 44011 562211 Hazardous Waste Treatment and Disposal	1,000 - 9,999	Ancillary
Shintech Plaquemine Plant C-K Tech Inc 26270 Hwy 405 Plaquemine, LA 70764 325211 Plastics Material and Resin Manufacturing	1,000,000 - 9,999,999	Produce, Byproduct
Clean Harbors Aragonite LLC Clean Harbors Inc 11600 North Aptus Rd Grantsville, UT 84029 562211 Hazardous Waste Treatment and Disposal	100,000 - 999,999	Ancillary

Facility ¹	Maximum Amount On-Site (lb)	Activity or Use
Clean Harbors Deer Park LLC Clean Harbors Inc 2027 Independence Parkway South La Porte, TX 77571 562211 Hazardous Waste Treatment and Disposal	100,000 - 999,999	Article Component
Clean Harbors El Dorado LLC Clean Harbors Inc 309 American Cir Union El Dorado, AR 71730 562211 Hazardous Waste Treatment and Disposal	10,000 - 99,999	Repackaging, Ancillary
Clean Harbors Environmental Services Inc Clean Harbors Inc 2247 S Hwy 71 Kimball, NE 69145 562211 Hazardous Waste Treatment and Disposal	10,000 - 99,999	Ancillary
Enterprise Products Operating LLC Enterprise Products Operating LLC 10207 FM 1942 Mont Belvieu, TX 77580 211112 Natural Gas Liquid Extraction	100,000 - 999,999	Imported, Used Processed, Chemical Processing Aid
Formosa Plastics Corp Louisiana Formosa Plastics Corp USA Gulf States Rd Baton Rouge, LA 70805 325211 Plastics Material and Resin Manufacturing	100,000 - 999,999	Produce, Manufacturer Impurity, Ancillary
Formosa Plastics Corp Texas Formosa Plastics Corp USA 201 Formosa Dr Point Comfort, TX 77978 325211 Plastics Material and Resin Manufacturing	100,000 - 999,999	Produce, Used Processed, Manufacturer Impurity, Formula Component, Process Impurity
Giant Cement Co Giant Cement Holding Inc Hwy 453 & I-26 (654 Judge St) Harleyville, SC 29448 327310 Cement Manufacturing	10,000 - 99,999	Ancillary
Heritage Thermal Services Heritage-WTI LLC 1250 St George St East Liverpool, OH 43920 562213 Solid Waste Combustors and Incinerators	10,000 - 99,999	Ancillary
Dover Chemical Corp ICC Industries Inc 3676 Davis Rd Dover, OH 44622 325998 All Other Miscellaneous Chemical Product and Preparation Manufacturing	100,000 - 999,999	Produce, Manufacturer Impurity, Manufacturer Aid
Occidental Chemical Corp Occidental Chemical Holding Corp 4133 Hwy 361 Gregory, TX 78359 325199 All Other Basic Organic Chemical Manufacturing	10,000 - 99,999	Produce, Byproduct, Ancillary

Facility ¹	Maximum Amount On-Site (lb)	Activity or Use
Occidental Chemical Corp Occidental Chemical Holding Corp 6200 S Ridge Rd Wichita, KS 67215 325180 Other Basic Inorganic Chemical Manufacturing	1,000,000 - 9,999,999	Produce, Used Processed, Sale Distribution, Repackaging, Ancillary
Occidental Chemical Holding Corp - Geismar Plant Occidental Chemical Holding Corp 8318 Ashland Rd Geismar, LA 70734 325199 All Other Basic Organic Chemical Manufacturing	50,000,000 - 99,999,999	Produce, Used Processed, Sale Distribution, Byproduct, Reactant, Manufacturer Aid
Oxy Vinyls LP Deer Park-VCM Plant Occidental Chemical Holding Corp 5900 Hwy 225 Gate 8A Deer Park, TX 77536 325199 All Other Basic Organic Chemical Manufacturing	10,000 - 99,999	Produce, Byproduct, Ancillary
Oxy Vinyls LP La Porte VCM Plant Occidental Chemical Holding Corp 2400 Miller Cutoff Rd La Porte, TX 77571 325199 All Other Basic Organic Chemical Manufacturing	10,000 - 99,999	Produce, Byproduct, Reactant, Manufacturer Aid
Ross Incineration Services Inc Ri Technologies Inc 36790 Giles Rd Grafton, OH 44044 562211 Hazardous Waste Treatment and Disposal	10,000 - 99,999	Ancillary
Rubicon LLC 9156 Highway 75 Geismar, LA 70734 325194 Cyclic Crude, Intermediate, and Gum and Wood Chemical Manufacturing	100 - 999	Produce, Byproduct
Sabic Innovative Plastics US LLC Sabic US Holdings LP One Plastics Dr Burkville, AL 36752 325211 Plastics Material and Resin Manufacturing	10,000 - 99,999	Produce, Manufacturer Impurity, Process Impurity
GB Biosciences Corp Syngenta Corp 2239 Haden Rd Houston, TX 77015 325320 Pesticide and Other Agricultural Chemical Manufacturing	1,000 - 9,999	Produce, Manufacturer Impurity
Syngenta Crop Protection LLC Saint Gabriel Facility Syngenta Corp 3905 Hwy 75 Saint Gabriel, LA 70776 325320 Pesticide and Other Agricultural Chemical Manufacturing	100,000 - 999,999	Produce, Byproduct, Chemical Processing Aid

Facility ¹	Maximum Amount On-Site (lb)	Activity or Use
Chemours Belle Plant The Chemours Co Fc LLC 901 W Dupont Ave Belle, WV 25015 325199 All Other Basic Organic Chemical Manufacturing	0 - 99	Produce, Byproduct
Chemours El Dorado The Chemours Co Fc LLC 322 Southfield Cutoff Rd El Dorado, AR 71730 325120 Industrial Gas Manufacturing	100,000 - 999,999	Reactant
Dow Chemical Co Freeport Facility The Dow Chemical Co 2301 N Brazosport Blvd Freeport, TX 77541 325199 All Other Basic Organic Chemical Manufacturing	1,000,000 - 9,999,999	Produce, Imported, Byproduct, Manufacturer Impurity, Reactant, Process Impurity, Chemical Processing Aid, Ancillary
Dow Chemical Co The Dow Chemical Co 901 Loveridge Rd Pittsburg, CA 94565 325320 Pesticide and Other Agricultural Chemical Manufacturing	10,000,000 - 49,999,999	Produce, Used Processed, Byproduct, Reactant, Chemical Processing Aid, Manufacturer Aid
The Dow Chemical Co - Louisiana Operations The Dow Chemical Co 21255 La Hwy 1 S Plaquemine, LA 70764 325199 All Other Basic Organic Chemical Manufacturing	1,000,000 - 9,999,999	Produce, Used Processed, Sale Distribution, Byproduct, Manufacturer Impurity, Reactant, Chemical Processing Aid, Ancillary
The Dow Chemical Co Grand Bayou Operations The Dow Chemical Co Louisiana Hwy 70 Paincourtville, LA 70391 212393 Other Chemical and Fertilizer Mineral Mining	0 - 99	Produce, Manufacturer Impurity
US Magnesium LLC The Renco Group Inc 12819 N Skull Valley Rd Grantsville, UT 84029 331410 Nonferrous Metal (except Aluminum) Smelting and Refining	10,000 - 99,999	Produce, Byproduct
Norlite LLC Tradebe Treatment & Recycling LLC 628 S Saratoga St Cohoes, NY 12047 327992 Ground or Treated Mineral and Earth Manufacturing	100 - 999	Ancillary

Facility ¹	Maximum Amount On-Site (lb)	Activity or Use
Unilin US MDF 149 Homanit USA Rd Mount Gilead, NC 27306 321219 Reconstituted Wood Product Manufacturing	0 - 99	Produce, Byproduct
Univar USA Inc Kansas City Univar USA Inc 2000 Guinotte Ave Kansas City, MO 64120 424690 Other Chemical and Allied Products Merchant Wholesalers	NA	NA
Veolia ES Technical Solutions LLC Port Arthur Facility Veolia Environmental Services Hwy 73 3.5 Miles W of Taylor Bayou Port Arthur, TX 77640 562211 Hazardous Waste Treatment and Disposal	10,000-99,999	Ancillary
Veolia ES Technical Solutions LLC Veolia Environmental Services 7 Mobile Ave Sauget, IL 62201 562211 Hazardous Waste Treatment and Disposal	1,000-9,999	Ancillary
Westlake Vinyls Co Westlake Chemical Corp 36045 Hwy 30 Geismar, LA 70734 325211 Plastics Material and Resin Manufacturing	1,000-9,999	Produce, Sale Distribution, Byproduct, Manufacturer Impurity
Westlake Vinyls Inc Westlake Chemical Corp 2468 Ind US Trial Pkwy Calvert City, KY 42029 325199 All Other Basic Organic Chemical Manufacturing	1,000,000-9,999,999	Produce, Used Processed, Reactant, Ancillary

Source: U.S. EPA (2014b)

¹ The 'Facility' column is hyperlinked to the corresponding RY 2014 report hosted on EPA's Envirofacts server.

5. National Emissions Inventory

The National Emissions Inventory (NEI) estimates the total air emissions of criteria pollutants, criteria precursors, and hazardous air pollutants in the United States. The tri-annual NEI datasets are compiled by EPA using data collected by state, local and tribal air agencies. The most recent NEI dataset was released in December 2016 based on emissions estimated for calendar year 2014.

A summary of the carbon tetrachloride emissions in the 2014 NEI is provided in Table 14. This table is grouped by NAICS code sectors at the 4-digit level and is limited to industry sectors with at least 1,000 pounds of carbon tetrachloride emissions. Of the 11 NAICS-4 industry sectors shown, Basic Chemical Manufacturing (3251) is the highest emitter of carbon tetrachloride followed by Pulp, Paper and Paperboard Mills (3221). The top emitting facilities are also presented in the table, limited to facilities with least 1,000 pounds of carbon tetrachloride emissions. In total, 3,246 facilities were listed in the NEI with data for carbon tetrachloride emissions. Many facilities, however, had near zero emissions; 2,204 facilities had less than below 1 lb released.

Table 11: Summary of 2014 NEI Carbon Tetrachloride Emissions Including Top Industry Sectors and Facilities

NAICS Code and Description / Facility Name and Location	Carbon Tetrachloride Emissions (lb)
3251 - Basic Chemical Manufacturing	89,961
Rubicon LLC - Geismar Plant (Geismar, LA)	27,800
Occidental Chemical Corporation - Geismar Plant (Geismar, LA)	16,526
OxyChem - Wichita (Wichita, KS)	12,262
The Dow Chemical Co - Louisiana Operations (Plaquemine, LA)	6,179
Texas Operations (Eastman Chemical Company) (Longview, TX)	4,755
Dover Chemical Corp (Dover, OH)	3,863
BASF Corp - Geismar Site (Geismar, LA)	2,895
Cabot Corp (Tuscola, IL)	2,540
Dow Texas Operations Freeport (Clute, TX)	2,489
Honeywell International Inc - Baton Rouge Plant (Baton Rouge, LA)	2,441
Eagle US 2 LLC - Lake Charles Complex (Westlake, LA)	2,206
Greens Bayou Plant (Houston, TX)	1,992
Westlake Vinyls Co LP (Geismar, LA)	1,156
All Other Facilities (30)	2,856
3221 - Pulp, Paper, and Paperboard Mills	49,024
Rayonier Performance Fibers, LLC (Fernandina Beach, FL)	8,892
Domtar Paper Co LLC - Hawesville Operations (Hawesville, KY)	3,863
International Paper Company (Cantonment, FL)	3,599
Westrock CP LLC (Florence, SC)	3,011
Domtar Paper Co LLC Marlboro Mill (Bennettsville, SC)	2,718
IP Valliant Paper Mill (Valliant, OK)	2,686
Georgia-Pacific LLC-Crossett Paper Oper (Crossett, AR)	2,430

NAICS Code and Description / Facility Name and Location	Carbon Tetrachloride Emissions (lb)
Evergreen Packaging - Pine Bluff (Pine Bluff, AR)	2,203
Georgia Pacific (Pennington, AL)	1,411
International Paper Georgetown Mill (Georgetown, SC)	1,282
Resolute FP US INC (Catawba, SC)	1,267
Verso Paper – Androscoggin Mill (Jay, ME)	1,157
All Other Facilities (95)	14,504
3252 - Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	5,350
Formosa Plastics Corp Louisiana (Baton Rouge, LA)	2,315
Shintech Louisiana LLC - Shintech Plaquemine Plant (Plaquemine, LA)	1,913
All Other Facilities (12)	1,123
2211 - Electric Power Generation, Transmission and Distribution (154 facilities)	5,118
3253 - Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	5,071
Dow Chemical Company (Pittsburg, CA)	3,471
Syngenta Crop Protection LLC - St Gabriel Plant (St. Gabriel, LA)	1,600
All Other Facilities (3)	0
3211 - Sawmills and Wood Preservation (126 facilities)	2,963
2213 - Water, Sewage and Other Systems (501 facilities)	2,816
3259 - Other Chemical Product and Preparation Manufacturing	2,647
Westlake Vinyls Inc (Calvert City, KY)	2,646
All Other Facilities (5)	0
3212 - Veneer, Plywood, and Engineered Wood Product Manufacturing (85 facilities)	2,524
4862 - Pipeline Transportation of Natural Gas (156 facilities)	2,007
5622 - Waste Treatment and Disposal (597 facilities)	1,098
All Other Industries (1,452 facilities)	6,280
Total (3,246 facilities)	174,859
Source: U.S. EPA (2016)	

6. References

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Appendix 1: Reported Activities and Uses on TRI Form R

Table 11, Table 12, and Table 13 include data derived from TRI Form R, Part II, Section 3: Activities and Uses of the EPCRA Section 313 Chemical at the Facility. These data qualitatively indicate the manufacture, processing, or otherwise use activities of the chemical at the reporting facility. The list below provides definitions for the activities listed in these tables.

Manufacture (Section 3.1)

- *"Produce"* indicates the toxic chemical was created by the facility. A toxic chemical is considered manufactured even if the toxic chemical is created unintentionally or exists only for a short period of time. (Section 3.1a)
- *"Imported"* indicates that the chemical is imported by the facility into the Customs Territory of the United States. (Section 3.1b)
- *"Sale Distribution"* indicates that the chemical is produced or imported specifically for sale or distribution outside the manufacturing facility. (Section 3.1c)
- *"Used Processed"* indicates that the chemical is produced or imported and then further processed or otherwise used at the same facility. (Section 3.1d)
- *"Byproduct"* indicates the toxic chemical is produced coincidentally during the manufacture, process, or otherwise use of another chemical substance or mixture and, following its production, is separated from that other chemical substance or mixture. This includes toxic chemicals that may be created as the result of waste management. (Section 3.1e)
- *"Manufacture Impurity"* indicates the facility produces the reported chemical as a result of the manufacture, processing, or otherwise use of another chemical, but does not separate the chemical, and it remains primarily in the mixture or product with that other chemical. (Section 3.1f)

Process (Section 3.1)

- *"Reactant"* indicates the toxic chemical is used in chemical reactions to create another chemical substance or product that is then sold or otherwise distributed to other facilities. Some examples of reactants include feedstocks, raw materials, intermediates, and initiators. (Section 3.2a)
- *"Formulation Component"* indicates the toxic chemical is used as an ingredient in a product mixture to enhance performance of the product during its use, such as dyes in ink, solvents in

paint, additions, reaction diluents, initiators, inhibitors, emulsifiers, surfactants, lubricants, flame retardants, and rheological modifiers. (Section 3.2b)

- “*Article Component*” indicates the toxic chemical becomes an integral part of an article distributed into commerce, such as copper in wire or resins in a plastic pen or the pigment components of paint applied to a chair that is sold. (Section 3.2c)
- “*Repackaging*” indicates the toxic chemical has been received by the facility and subsequently prepared for distribution into commerce in a different form, state, or quantity than it was received, such as petroleum being transferred from a storage tank to tanker trucks. (Section 3.2d)
- “*Process Impurity*” indicates the facility processed the reported chemical but did not separate it, and it remains as an impurity in the primary mixture or trade name product. (Section 3.2e)

Otherwise Use (Section 3.1)

- “*Chemical Processing Aid*” indicates the toxic chemical is used to aid in the manufacture or synthesis of another chemical substance such that it comes into contact with the product during manufacture, but is not intended to remain with or become part of the final product or mixture. Some examples of chemical processing aids are process solvents, catalysts, solution buffers, inhibitors, and reaction terminators. (Section 3.3a)
- “*Manufacture Aid*” indicates the toxic chemical is used to aid in the manufacturing process but does not come into contact with the product during manufacture. Some examples include valve lubricants, refrigerants, metalworking fluids, coolants, and hydraulic fluids. (Section 3.3b)
- “*Ancillary*” indicates that the chemical is used at the facility for purposes other than aiding chemical processing or manufacturing. (Section 3.3c)