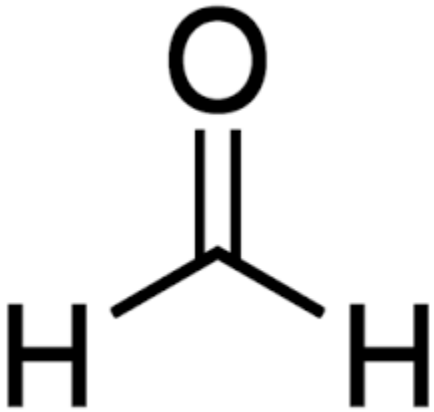
United States
Environmental Protection Agency

March 2024
Office of Chemical Safety and
Pollution Prevention

Draft Environmental Release Assessment for Formaldehyde

CASRN 50-00-0



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Key Points: Environmental Release Assessment for Formaldehyde

EPA considered all reasonably available information identified through its systematic review process under TSCA to evaluate releases of formaldehyde into the environment. The following bullets summarize the key points of this draft environmental release assessment:

- Formaldehyde is directly released to all three environmental media (air, land, and water)
- Formaldehyde is released from TSCA and non-TSCA uses as well as living or biogenic sources.
- Formaldehyde is also released to the environment as a transformation product of different parent chemicals and from combustion sources.
- The highest reported emitters of formaldehyde are affiliated with the following industrial sectors:
  - Oil and Gas Drilling, Extraction, and Support Activities (NAICS 211 & 213)
  - Wood Product Manufacturing (NAICS 321)
  - Wholesale and Retail Trade- Airport Operations (NAICS 48)

EXECUTIVE SUMMARY

Formaldehyde is released into the environment through discharges into water bodies, via land disposal methods, or emissions into the air. The Agency reviewed release data from EPA's Toxics Release Inventory (TRI data from 2016 to 2021), Discharge Monitoring Report (DMR data from 2016 to 2021), and the 2017 National Emissions Inventory (NEI) to identify relevant releases of formaldehyde to the environment. These sources provide site-specific release information based on measurements, mass balances, or emission factors. In addition, EPA also considered other relevant release data to help fill data gaps from other peer-reviewed or grey literature sources identified through systematic review.

EPA determined that based on the fate properties of formaldehyde, additional analyses of releases to water or land was not needed and targeted its review of release information to air emissions of formaldehyde from Toxic Substances Control Act conditions of use (TSCA COUs). The Agency identified more than 150,000-point source emission data records (at the unit-level estimates) for formaldehyde across the TRI and NEI databases (Appendix A). To characterize this amount of data, EPA utilized the self-reported NAICS codes to assign sites into industrial sectors. These industrial sectors can be directly correlated with the TSCA COUs, as further discussed in Section 2.1, Appendix B, and Appendix C.

Overall, EPA identified approximately 800 TRI facilities and approximately 50,000 NEI facilities with air release estimates of formaldehyde, as discussed in Section 2.2, Appendix D, and Appendix E. Between 2016 and 2021, the maximum release reported through TRI for TSCA COUs was 10,161 kg/year-site for fugitive release and 158,757 kg/year-site for stack release. The NEI program identified sites reporting as high as 138,205 kg/year-site for fugitive releases and 1,412,023 kg/year-site for stack releases. EPA analyzed the release information by their industrial sector, providing the median and 95th percentiles in Appendix D. In general, EPA has a moderate to robust weight of the scientific evidence for environmental releases for industrial COUs and a moderate weight of the scientific evidence for commercial COUs. Some commercial COUs were only qualitatively assessed due to limited information on the COU.

1 INTRODUCTION

This document provides details on the environmental release assessment and supplemental information used to support the environmental and general population exposure assessments and associated risk assessments for the draft formaldehyde risk evaluation. EPA assesses environmental releases based on formaldehyde's conditions of use (COUs) under the Toxic Substances Control Act (TSCA).

Formaldehyde is released into the environment through TSCA COUs, non-TSCA uses, and naturally through biological means. Formaldehyde is also found in the environment from combustion sources and transformation products of different parent chemicals.

EPA reviewed release data from the Toxics Release Inventory (TRI[1] data from 2016 to 2021), Discharge Monitoring Report (DMR[2] data from 2016 to 2021), and the 2017 National Emissions Inventory (NEI[3]) to identify relevant releases of formaldehyde to the environment. While these databases sufficiently informed industrial/processing COUs, the databases are limited in data on environmental releases for commercial COUs. For commercial COUs, EPA also reviewed expected production volumes, concentrations, and release sources to inform release potential for these COUs.

Based on a review of the various databases, EPA confirmed formaldehyde is released to land, water, and air. These databases may not identify all formaldehyde releases as some facilities may not be required to report. Due to its reactivity, formaldehyde is not expected to persist in land or water; therefore, only a summary of land and water releases is provided (see Appendix D). However, formaldehyde is a highly volatile chemical and therefore air releases from TSCA uses are expected and were estimated for the COUs within the scope of the risk evaluation. This assessment provides a detailed review of formaldehyde air releases.

1.1 Risk Evaluation Scope

This draft TSCA risk evaluation of formaldehyde comprises several human health and environmental assessment modules and two risk assessment documents—the ecological risk assessment and the human health risk assessment. A basic diagram showing the layout of these modular assessments and their relationships is provided in Figure 1-1. This environmental release assessment is shaded blue. In some cases, modular assessments were completed jointly under TSCA and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). These modules are shown in dark gray.

[1] See Appendix F.1 for additional details and the TRI website.
[2] See Appendix F.3 for additional details and the DMR website.
[3] See Appendix F.2 for additional details and the NEI website.

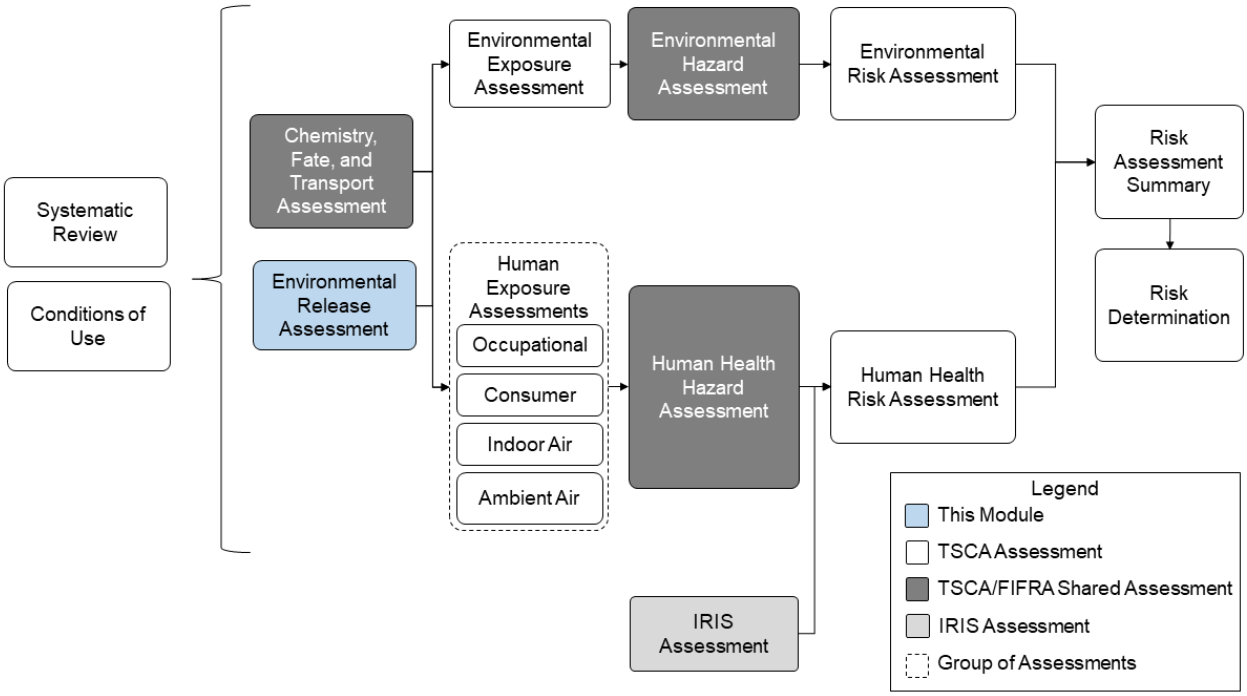

Figure 1-1. Risk Evaluation Document Summary Map

2 FORMALDEHYDE AIR RELEASES

2.1 Approach and Methodology

2.1.1 General Approach and Methodology for Environmental Releases

Releases to the environment may be derived from reported data that are obtained through direct measurement via monitoring, calculations based on empirical data, and/or assumptions and models. EPA used the following evidence integration hierarchy in selecting data and approaches for assessing environmental releases:

1. Monitoring and measured data
    a. Releases calculated from site-specific concentration in media and flow rate data
    b. Releases calculated from mass balances or emission factor methods using site-specific measured data
2. Modeling approaches
    a. Surrogate release data
    b. Fundamental modeling approaches
    c. Statistical regression modeling approaches
3. Release limits
    a. Company-specific limits
    b. Regulatory limits (*e.g.*, National Emission Standards for Hazardous Air Pollutants [NESHAPs]) or effluent limitations/requirements

EPA's preference is to rely on facility-specific release data reported in TRI and NEI, where available. These sources provide site-specific release information based on measurements, mass balances, or emission factors. In addition, NEI may provide release information at the process unit-level with process-specific stack parameters which can be used for further refinement of the modeling of the air release data, which EPA considers to be a higher tier analysis. For this assessment, the Agency used the site-level air release estimates from NEI. EPA's general approach to estimating releases from these sources including the use of DMR for water releases is described in Appendix F.

2.1.2 Industrial Sector Air Release Analysis

EPA developed the air release estimates included in this assessment using the 2016 through 2021 reporting years for TRI (U.S. EPA, 2022c) and 2017 NEI (U.S. EPA, 2019b). EPA identified more than 150,000 emission data records (including unit-level estimates) for formaldehyde across the two databases.

Due to the large number of release records in TRI and NEI, EPA developed a tiered approach for assessing releases. This approach is discussed below and is designed to be a high-throughput, tier 1 approach for evaluating large release datasets while also providing the necessary information to support a TSCA risk evaluation.

Step 1. Crosswalk to Industrial Sector

The lower tiered approach that EPA developed for formaldehyde uses the facility reported primary NAICS codes to associate sites to Conditions of Use. This approach does not require review of the additional meta-data included in TRI and NEI, such as source classification codes (SCC) codes, which EPA considers to be a higher tier mapping approach.

The COUs are primarily informed using Chemical Data Reporting (CDR), which requires manufacturers and importers of formaldehyde (among other chemical substances) to provide downstream use information including relevant industrial sectors. For a given COU, the descriptor includes the lifecycle stage, type of process, function, and industrial sector(s).

In the tiered approach, sites are first assigned to a CDR Industrial Sector (IS), using the crosswalk provided in Appendix B.2 and summarized in Table_Apx C-1. For example, a site that reports a primary NAICS code of 326113, Unlaminated Plastics Film and Sheet (except Packaging**)** Manufacturing, is linked to the CDR IS code of 35, Plastics Product Manufacturing. This industrial sector is listed under one COU:

- Processing – Reactant – Intermediate in: Pesticide, fertilizer, and other agricultural chemical manufacturing; Petrochemical manufacturing; Soap, cleaning compound, and toilet preparation manufacturing; All other basic organic chemical manufacturing; Plastic materials and resin manufacturing; Adhesive manufacturing; All other chemical product and preparation manufacturing; Paper manufacturing; Paint and coating manufacturing; Plastic products manufacturing; Synthetic rubber manufacturing; Wood product manufacturing; Construction; Agriculture, forestry, fishing, and hunting

An industrial sector may be associated with multiple COUs. Industrial sector analysis was completed with all sites that fell under the primary NAICS code. The most granular level of NAICS is a six-digit code. Of note, CDR industrial sectors can vary on the level of granularity to the corresponding NAICS code. In some cases, an industrial sector is directly related to a 6-digit NAICS code, while other industrial sectors relate to a 2-digit NAICS subsector that may contains several 6-digit NAICS codes.

Step 2. Industrial Sector Statistical Analysis

For the tiered approach, EPA developed the release statistics listed below for each industrial sector to which facilities are mapped:

- Minimum, nonzero, annual fugitive emission
- Minimum, nonzero, annual stack emission
- Median, nonzero, annual fugitive emission
- Median, nonzero, annual stack emission
- 95th Percentile, nonzero, annual fugitive emission
- 95th Percentile, nonzero, annual stack emission
- Maximum, nonzero, annual fugitive emission
- Maximum, nonzero, annual fugitive emission

Step 3. Crosswalk Industrial Sector to Condition of Use

During collection of air release data, EPA identified air release information for industrial sectors that were not directly specified within the processing/industrial COUs. The release information is included in the Supplemental File: Air Release Summary for TRI and NEI for Formaldehyde. These industrial sectors are listed below. As commercial COUs do not list their respective industrial sectors, some of these industrial sectors were used as data to support commercial COUs. In addition, EPA used additional use information from TRI to identify potentially relevant industrial COUs (Appendix C).

- Computer and Electronic Product Manufacturing
- Custom Compounding of Purchased Resin
- Electrical Equipment, Appliance, and Component Manufacturing
- Explosives Manufacturing
- Fabricated Metal Product Manufacturing

- Food, beverage, and tobacco product Manufacturing
- Furniture and Related Product Manufacturing
- Industrial Gas Manufacturing
- Machinery Manufacturing
- Mining (except Oil and Gas) and Support Activities
- Nonmetallic Mineral Product Manufacturing
- Organic Fiber Manufacturing
- Petroleum Refineries
- Pharmaceutical and Medicine Manufacturing
- Photographic Film Paper, Plate, and Chemical Manufacturing
- Primary Metal Manufacturing
- Printing and Related Support Activities
- Printing Ink Manufacturing
- Synthetic Dye and Pigment Manufacturing
- Utilities

2.1.3 Air Release Potential Analysis

Where available, EPA used TRI and NEI to inform air releases from commercial COUs. However, facilities are only required to report to TRI if the facility has 10 or more full-time employees; is included in an applicable North American Industry Classification System (NAICS) code; and manufactures, processes, or uses the chemical in quantities greater than a certain threshold. Reporting to NEI depends on submissions voluntarily provided by state, local, and tribal agencies and is supplemented by data from other EPA programs. For NEI, the general threshold for major source is the potential to emit more than 10 tons per year for a single Hazardous Air Pollutant (HAP), or 25 tons per year for any combination of HAPs.

Due to these limitations, commercial sites that use formaldehyde and/or formaldehyde-containing products may not report to TRI or NEI and are therefore not included in these datasets. Therefore, EPA also used data from literature, emission scenario documents (ESDs), and generic scenarios (GSs) to inform the air release potential from these commercial uses.

2.2 Air Release Estimates of Formaldehyde

2.2.1 By Geographical Location

EPA mapped the maximum total annual air emissions from TRI facilities between the reporting years of 2016 through 2021 and NEI facilities reported in 2017, in the states and tribal territories for the contiguous United States (See Figure 2-1). The yellow dots represent sites with low air releases of formaldehyde while the blue dot represent the sites with the highest air releases of formaldehyde. In some cases, dots may overlap within the map with the highest release category visible.

The regions with the highest activity of facilties with air releases of formaldehyde were regions 4 (KY, TN, NC, SC, GA, AL, MS, FL), 5 (MN, WI, IL, IN, MI, OH) and 6 (OK, AR, LA, TX, NM). As previously discussed, TRI only requires sites with specific NAICS codes to report; therefore, NEI identified significantly more sites including industrial sectors not required to be reported to TRI. For example, the industrial sector Oil and Gas Drilling, Extraction, and Support Activities refers to all 6-digit codes under NAICS subsector 211 and 213, however only one 6-digit NAICS code under the subsector is required to report to TRI: 211130 Natural Gas Extraction (and limited to facilities that

recover sulfur). This industrial sector has the highest identified site-specific emission of 1,412,022 kg/year-site reported in NEI.

The NEI database also contains sites related to other industrial sectors reportable to TRI but not identified in TRI such as Agriculture, Forestry, Fishing, and Hunting. These differences may be due to the formaldehyde manufacturing/processing/use threshold associated with the TRI program. Several of these NEI facilities reported less than 1 kg/year. Figure 2-2 presents the same maps with only sites releasing more than 4,100 kg/year.

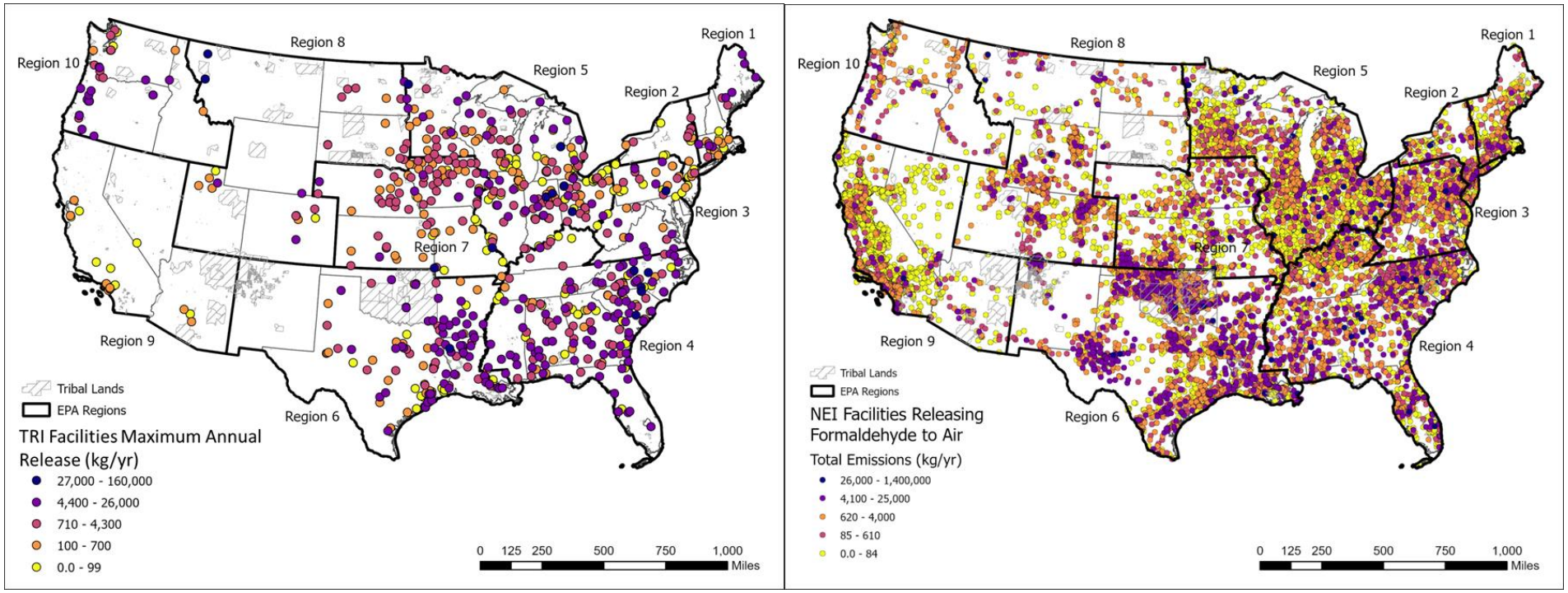

Figure 2-1. Formaldehyde Annual Air Releases by TRI Facilities between 2016 through 2021 and NEI Facilities from 2017

Note: For each TRI facility, the highest combined stack and fugitive air releases reported between 2016 through 2021 was used. Therefore, not all of these release estimates shown in the figure occurred within the same year. Not shown are the sites located in Alaska, American Samoa, Guam, Hawaii, N. Mariana Islands, Puerto Rico, and the U.S. Virgin Islands. Due to the larger number of facilities, the dot size was reduced for the NEI facilities map to reduce overlapping circles.

2.2.2 By Conditions of Use

EPA analyzed site data for nonzero fugitive emissions and stack emissions from six years of TRI Form R data and 2017 NEI to characterize the distribution of fugitive and stack emission data for each industrial sector. These percentile estimates do not consider Form A TRI reporters, which are not required to provide a numerical estimate (see Appendix F). EPA only considered the total releases from the site and the primary NAICS code reported by the sites. Each site was considered within its industrial sector, which can be associated with one or more COUs. Appendices D.4 and D.5 provide the air release estimates associated with the COUs. Table 2-1 presents a summary of the air release estimates for each database across all industrial sectors and COUs.

Table 2-1. Annual Fugitive and Stack Air Release Estimates Based on TRI and NEI

Database	Annual Fugitive Air Release (kg/yr-site)			Annual Stack Air Releases (kg/yr-site)		
	Median	95th Percentile	Maximum	Median	95th Percentile	Maximum
TRI (2016-2021)	27	1,244	10,161[a]	710	13,866	158,757
NEI (2017)	0.33	473	138,205	8	4,995	1,412,023

[a] The maximum fugitive release in the TRI dataset was 14,272 kg/yr-site. This was in the Food, beverage, and tobacco manufacturing, which EPA does not consider to be associated with an in-scope TSCA COU.

In total, about 800 Form R TRI reporters with air emission data were identified and 49,710 facilities with reported releases in NEI. TRI reporters with combined stack and fugitive air emissions of zero and NEI facilities with combined stack and fugitive air emission estimates of zero were not included. TRI and NEI are separately evaluated. Analysis of TRI data is multi-year with a site's estimates for each year included while NEI is a snapshot of sites for one year, 2017. Appendix E lists the number of sites per reporting program for each industrial sector.

In many cases, NEI contained sites with very low (less than 0.5 lb) of air releases reporting. Therefore, as shown in Table 2-1, the median and 95th percentile for NEI tend to be lower than TRI. The maximum reported annual emission in NEI are generally similar or higher than TRI.

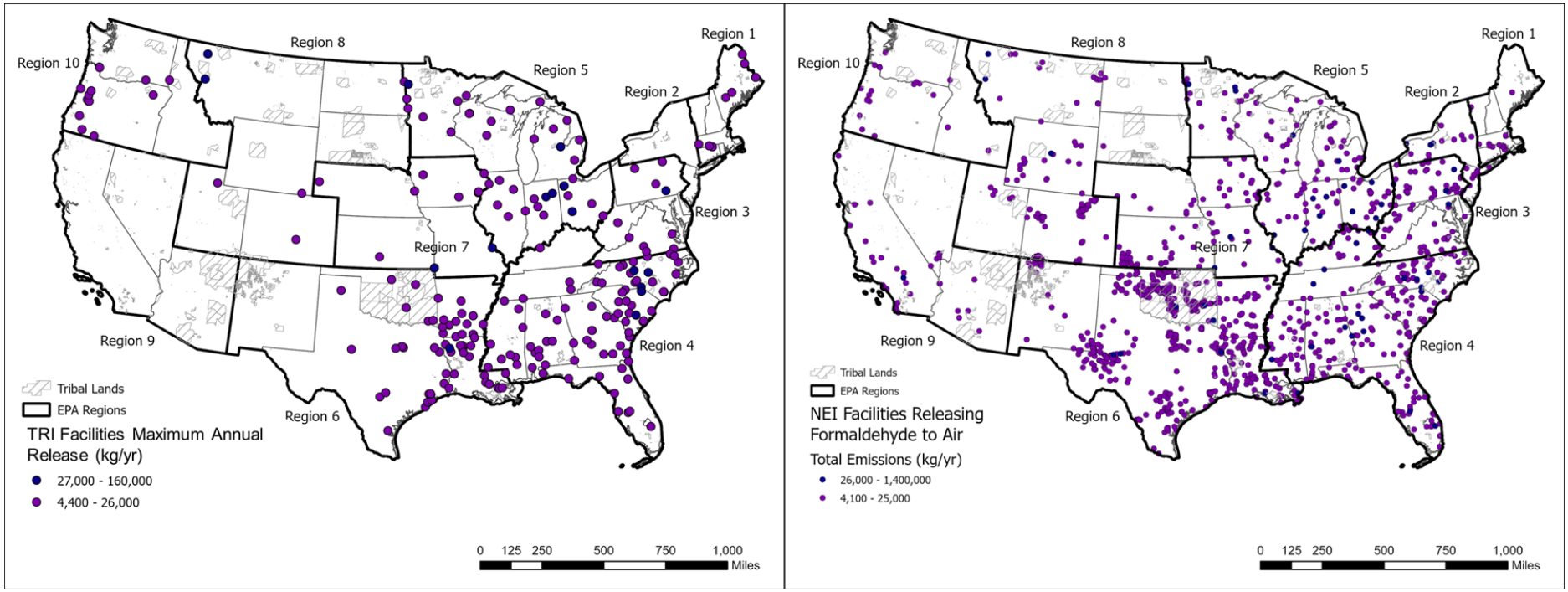

Figure 2-2. Formaldehyde TRI Facilities between 2016 through 2021 and NEI Facilities from 2017 with Annual Air Releases above 4,100 kg/year

Note: For each TRI facility, the highest combined stack and fugitive air releases reported between 2016 through 2021 was used. Therefore, not all of these release estimates shown in the figure occurred within the same year. Not shown are the sites located in Alaska, American Samoa, Guam, Hawaii, N. Mariana Islands, Puerto Rico, and the U.S. Virgin Islands. Due to the larger number of facilities, the dot size was reduced for the NEI facilities map to reduce overlapping circles.

For some industrial COUs, an industrial sector is not directly specified for the COU within the COU table. EPA therefore assigned an appropriate industrial sector for the industrial COU based on professional judgement (see Table 2-2). For commercial COUs, EPA considered surrogate NEI or TRI industrial sector (IS) data, GSs, ESDs, or literature sources to develop estimates for commercial uses. These estimates are provided as ranges and the detailed analysis of the reasonably available information for each commercial COU is provided in Appendix G.

Table 2-2. Manually Assigned Industrial Sectors (IS) for Some Industrial COUs

COU	IS	Basis
Processing – incorporation into a formulation, mixture, or reaction product – laboratory chemicals	All Other Chemical Product and Preparation Manufacturing	EPA expects the formulating of laboratory chemicals to fall under all other chemical products.
Recycling	Plastics Product Manufacturing	Recycling streams within manufacturing processes are expected to be considered within their respective COU; End-product recycling may occur with plastic, paper and wood products; therefore, EPA assigns Plastics Product Manufacturing, Paper Manufacturing, or Wood Product Manufacturing as surrogates for this COU.
	Paper Manufacturing	
	Wood Product Manufacturing	
Distribution in commerce	N/A	EPA considers this COU to refer to accidental releases of the compound during spill events while transporting for distribution, which is not assigned an industrial sector as the nature of the release is accidental. This is further discussed in Appendix G.1
Industrial use – non – incorporative activities-oxidizing/reducing agent; processing aids, not otherwise listed	Computer and Electronic Product Manufacturing	Formaldehyde is used as a reducing agent during electroless copper plating (EPA-HQ-OPPT-2018-0438-0050) for printed circuit board manufacturing. The bare printed circuit board manufacturing (NAICS 334412) falls under the NAICS subsector/CDR industrial sector of Computer and Electronic Product Manufacturing (NAICS 334/IS 41). Fabricated Metal Product Manufacturing and Organic Fiber Manufacturing were assigned based on use information for TRI.
	Fabricated Metal Product Manufacturing	
	Organic Fiber Manufacturing	
Industrial Use – chemical substances in industrial products – paints and coatings; adhesives and sealants, lubricants	Transportation equipment manufacturing	EPA assigned transportation equipment manufacturing based on public comments from industry that formaldehyde was used in this manner for aircraft manufacturing. Paints, coatings, adhesives, sealants, and lubricants can also be potentially used across several industrial sectors.
	Fabricated Metal Product Manufacturing	
	Furniture and related product manufacturing	
	Electrical Equipment,	

COU	IS	Basis
	Appliance, and Component Manufacturing	
	Primary Metal Manufacturing	

2.3 Weight of the Scientific Evidence Conclusions for Environmental Releases from Industrial and Commercial Sources

EPA's weight of the scientific evidence is based on the strengths, limitations, and uncertainties associated with the release estimates. The Agency considers factors that increase or decrease the strength of the evidence supporting the release estimate—including quality of the data/information, applicability of the release data to the COU (including considerations of temporal relevance and locational relevance) and the representativeness of the estimate for the whole industry.

2.3.1 Strengths, Limitations, Assumptions, and Key Sources of Uncertainty for the Environmental Release Assessment

Strengths

EPA compiled release information using reported releases from the 2016 to 2021 TRI (U.S. EPA, 2022c), 2016-2021 DMR (U.S. EPA, 2022b), and 2017 NEI (U.S. EPA, 2019b). TRI, DMR, and NEI data were determined to have a high data quality rating through EPA's systematic review process. Furthermore, TRI-reporting facilities may measure or monitor emission if it is pre-existing available data (*e.g.*, stack releases can be directly measured by stack testing using EPA reference methods providing a directly measured emission rate which can then be used to calculate annual emissions). When monitoring or direct measurement data are not reasonably available or are known to be non-representative for TRI reporting purposes, the TRI regulations require that facilities determine release and other waste management quantities of TRI-listed chemicals by making reasonable estimates.

For formaldehyde, EPA identified that most emission estimates were based on emission factors with a smaller percentage using monitored data, mostly for estimation of stack emissions. For fugitive emissions reported in TRI for formaldehyde, 34 percent of these estimates indicated use of published emission factors, 34 percent reported other, 17 percent reported on-site-specific emission factors, 10 percent reported mass balance calculations, 4 percent reported periodic/random monitoring data, and 1 percent reported continuous monitoring data use. For stack emissions used from TRI for formaldehyde, 27 percent reported other, 25 percent reported on-site-specific emission factors, 23 percent of these estimates indicated use of published emission factors, 14 percent reported periodic/random monitoring data, 9 percent reported mass balance calculations, and 2 percent reported continuous monitoring data use.

NEI does not require stack testing or continuous emissions monitoring, and reporting agencies may use different emission estimation methods. These reasonable estimates may be obtained through various release estimation techniques, including continuous emissions monitoring, stack testing, mass-balance calculations, the use of emission factors, and engineering calculations.

Limitations

Facilities are only required to report to TRI if the facility has 10 or more full-time employees, is included in an applicable NAICS code, and manufactures, processes, or uses the chemical in quantities greater than a certain threshold (25,000 lb for manufacturers and processors and 10,000 lb for users).

The Air Emissions Reporting Rule (AERR) that serves as a basis for the NEI only requires criteria air pollutant (CAP) data reporting; data reporting for hazardous air pollutants (HAPs) such as formaldehyde is currently voluntary. As a result, for the NEI, EPA augments state, local, and tribal (SLT)-provided HAP data with other information to better estimate emissions. For point sources, HAP augmentation is performed on each emissions source using the WebFIRE database or data from TRI. DMR data are submitted by NPDES permit holders to states or directly to the EPA according to the monitoring requirements of the facility's permit. States are only required to load major discharger data into DMR and may or may not load minor discharger data. The definition of major vs. minor discharger is set by each state and could be based on discharge volume or facility size. Due to these limitations across programs, some sites may release formaldehyde but are not included in TRI, NEI, or DMR. It is uncertain the extent to which sites not captured in these databases release formaldehyde into the environment or whether releases are to water, air, or landfill.

In addition, the CDR industrial sectors range in granularity with some industrial sectors corresponding to 6-digit NAICS code while others correspond to 2-digit NAICS codes, which is a larger categorization than 6-digit NAICS code. These broad industrial sectors can lead to large variations within emissions per industrial sector. However, even within the same 6-digit NAICS codes, variations in production volumes, use of pollution control devices, and estimation methods can also explain the site to site variations.

EPA targeted its review of environmental releases to point sources, and did not review the road, nonroad, and other automotive exhaust information identified. EPA's approach used total facility emissions. For formaldehyde, the potential contribution of combustion sources is an uncertainty and use of the full facility data complicate singular TSCA COU estimates, such that emissions at one site may include multiple sources under multiple COUs which include combustion sources and non-combustion sources. With TRI, sites may report byproduct use codes to indicate these scenarios, but emissions are only provided at a per-site level. NEI data varies with many sites providing source classification codes with each emission estimate.

EPA identified some uses of formaldehyde that are excluded from the TSCA definition of "chemical substance" (i.e., non-TSCA uses). Some of these non-TSCA uses include, but are not limited to, fumigation uses in animal and poultry housing, biocide uses in water and fuel treatments, formalin uses as a drug in fish hatcheries, and in the manufacture of animal feeds. These non-TSCA uses may operate in the same industrial sectors as are included in the TSCA COUs, and the use information available is typically not sufficient to determine jurisdiction of sites. Therefore, EPA considered all sites within an industrial sector included in the scope but notes that some sectors may have sites that could use formaldehyde in non-TSCA activities.

Assumptions and Uncertainties

Although water releases did not undergo a full quantitative analysis, EPA provides the results from DMR for formaldehyde. EPA notes that there is some uncertainty in the DMR data pulled using the ECHO Pollutant Loading Tool Advanced Search option. The average measurements may be reported as a quantity (kg/day) or a concentration (mg/L). Calculating annual loads from concentrations requires adding wastewater flow to the equation, which increases the uncertainty of the calculated annual load. In addition, for facilities that reported having zero pollutant loads to DMR, the EZ Search Load Module uses a combination of setting non-detects equal to zero and as one-half the detection limit to calculate the annual pollutant loadings. This method could cause overestimation or underestimation of annual and daily pollutant loads. A strength of using DMR data and the Pollutant Loading Tool is that the tool calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA

and extrapolating over the course of the year. However, this approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year.

There is additional uncertainty in daily release estimates for air emissions. Facilities reporting to TRI and NEI report annual air emissions; to assess daily air emissions, EPA assumed a continuous value of 365 release days, 24/7 and averaged the annual releases over these days. Some sites do not operate year-round; therefore, the actual average daily releases may be higher if sites operate for fewer than 365 days. EPA also modeled for 250 release days, 8 hours per day.

For the characterization of releases per COU, EPA developed an approach to streamline analysis using the facility's primary NAICS code. The primary NAICS code corresponds to the primary economic activity at that facility. This approach does not rely on the TRI use codes or NEI SCC codes, which EPA views as a higher tier characterization. For TRI, a facility can also provide additional NAICS codes. Some sites are multi-use complexes where the activity of formaldehyde may not be best represented by the primary NAICS code. There is some uncertainty if a site's primary NAICS code will assign it to the appropriate COU.

2.3.2 Overall Weight of Scientific Evidence

Table 2-3 present the overall weight of scientific evidence for the air release estimates of formaldehyde. The best professional judgment is summarized using the descriptors of robust, moderate, slight, or indeterminant, according to EPA's *Draft Systematic Review Protocol Supporting TSCA Risk Evaluation for Chemical Substances Version 1.0* (U.S. EPA, 2021a).

Table 2-3. Overall Weight of Scientific Evidence

COUs	Reported Data	Modeled	Rationale
Industrial cous (manufacturing, processing, industrial use)	✓	×	***Moderate to Robust:*** For industrial COUs, EPA estimated air releases based on TRI and NEI. EPA has a moderate to robust weight of scientific evidence as the data sources have high data quality and are supported by numerous data points. A primary strength of TRI and NEI data is that these programs compile the best readily available release data for large facilities. The primary limitation is that these programs may not cover some sites that emit formaldehyde as both programs are associated with thresholds. In addition, EPA assumes a year-round operation for each industrial sector as a first tier modeling approach, which may not be applicable for every site. For formaldehyde, the contribution of combustion sources and use of the full facility data complicate singular COU estimates, such that emissions at one site may include combustion sources. Lastly, the estimation approaches as reported in TRI indicate release estimates primarily from emission factors. Emission factors can vary in their representativeness depending on the assumptions and data that support the emission factors. This leads to some uncertainty in the estimates.
Commercial use – chemical substances in treatment/care products – laundry and dishwashing products	×	×	***Indeterminate:*** EPA was not able to identify suitable sector from TRI or NEI and limited information on the chemical concentration of formaldehyde in laundry products.
Commercial use – chemical substances in treatment products – water treatment products	×	×	***Indeterminate:*** EPA was not able to identify suitable sector from TRI or NEI and limited information on this COU.
Commercial use – chemical substances in outdoor use products – explosive materials	×	×	***Slight:*** EPA provides a qualitative analysis on the air releases from this COU. EPA identified only one source that measured emissions of formaldehyde from the use of pyrotechnics. EPA is uncertain the additional type of explosive products where formaldehyde may be present.
Commercial use – chemical substances in products not described by other codes – other: laboratory chemicals	×	×	***Slight:*** EPA provides a qualitative analysis on the air releases from this COU. EPA uses a generic scenario, which has a high data quality rating but is not specific to formaldehyde use within labs.
All other commercial COUs	✓	×	***Moderate:*** In general, for commercial COUs, EPA has a moderate weight of scientific evidence as TRI and NEI have high data quality and GS or ESDs have a medium to high data quality rating. EPA did rely on professional judgement in mapping TRI and NEI industrial sectors to commercial COUs. There is some uncertainty that a commercial COU may occur across several industrial sectors beyond the industrial sector used for analysis. In addition,

COUs	Reported Data	Modeled	Rationale
			some industrial sectors cover both industrial and commercial operations, so they may overestimate air releases occuring in a commercial setting.
Disposal	✓	×	***Moderate to Robust:*** For disposal COU, EPA estimated air releases based on TRI and NEI. EPA has a moderate to robust weight of scientific evidence as the data sources have high data quality and are supported by numerous data points. A primary strength of TRI and NEI data is that these programs compile the best readily available release data for large facilities. The primary limitation is that these programs may not cover some sites that emit formaldehyde as both programs are associated with reporting criteria. In addition, EPA assumes a year-round operation for each industrial sector as first tier modeling approach, which may not be applicable for every site. For disposal, the industrial sector of Services for NEI includes several NAICS code beyond expected disposal activities, such that this estimate may not best characterize the distribution of air releases from disposal.

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APPENDICES

Appendix A LIST OF ENVIRONMENTAL RELEASE ASSOCIATED SUPPLEMENTAL FILES

Environmental Release Associated Supplemental Information Files- Provides all of the site-specific release information used for the assessment. The supplemental files are divided by media.

1.1. Supplemental Air Release Summary and Statistics for NEI and TRI for Formaldehyde.xlsx
1.2. Supplemental Land Release Summary for TRI for Formaldehyde.xlsx
1.3. Supplemental Water Release Summary for DMR and TRI for Formaldehyde.xlsx

Appendix B COU-IS MAPPING AND CROSSWALK

This appendix contains additional information about the relationship and mapping process between COUs and the industrial sectors as used for the formaldehyde draft risk evaluation.

Condition of Use (COU): TSCA section 3(4) defines COUs as "the circumstances, as determined by the Administrator, under which a chemical substance is intended, known, or reasonably foreseen to be manufactured, processed, distributed in commerce, used, or disposed of". COUs included in the scope of EPA's risk evaluations are typically tabulated in scope documents and risk evaluation documents as summaries of life cycle stages, categories, and subcategories of use. Therefore, a COU is composed of a combination of life cycle stage, category, and subcategory. COU development may include Chemical Data Reporting (CDR) information, market profile information, and literature sources.

Occupational Exposure Scenario (OES): This term is generally intended to describe the grouping or segmenting of COUs for assessment of releases and exposures. For example, EPA may assess a group of multiple COUs together as one OES due to similarities in release and exposure sources, worker activities, and use patterns. Alternatively, EPA may assess multiple OESs for one COU because there are different release and exposure potentials for a given COU. OES determinations are largely driven by the availability of data and modeling approaches to assess occupational releases and exposures. For formaldehyde, EPA encountered a difference in the granularity of the data available between releases and occupational exposures. For releases, many of the information (e.g., TRI, DMR) is provided at the site-level which can be driven by multiple different process with different worker activities and potential exposures. For example, a public commenter indicated that they manufacture formaldehyde and process it as a reactant which may occur at different areas of the plant. Therefore, EPA developed a new categorization for the release assessment. This new categorization approach, in addition, provided a more efficient process for handling the large dataset of release information for formaldehyde. The standard process of mapping site-specific release information to OESs requires review of TRI use codes, NEI SCC codes, and web searches to map a site to a specific OES. For this assessment, the categorization uses 'industrial sectors' as described below, which uses a standardized approach that can be used across different reporting databases. OESs will be further introduced in the Occupational Exposure Module, where it is used exclusively for the occupational exposure assessment for the formaldehyde draft risk evaluation.

*Industrial Sector (IS):*This term is based on the CDR industrial sectors, as defined in the Instructions for Reporting 2020 TSCA CDR. Industrial Sectors § 711.15(b)(4)(i)(B) are required to be provided by submitters of CDR to describe how the chemical is used or processed. Industrial sector is one component of the combination of use information required in 2020 CDR. In addition, the type of process or use operation and the function category are also provided and this information is used in the development of COUs. This data element is only required for activities under industrial processing and use, while commercial and consumer uses follow different reporting codes. A crosswalk of NAICS code and IS codes (see Appendix B.1) were developed by EPA, to connect industrial sectors to NAICS code for CDR reporting. EPA utilized that crosswalk to assigned sites reporting in TRI and NEI to industrial sectors using their NAICS code reported in their respective databases. For formaldehyde, an industrial sector was occasionally reported under different COUs, therefore an industry sector analysis may characterize multiple COUs.

B.1 Example COU-IS Mapping

Correlation between COU and IS

Generally, the format of a COU matches closely to the combination of use reporting as required in CDR. For formaldehyde, the majority of the COUs were developed based on CDR, and thus follows this format. Table_Apx B-1 displays an example COU and the location of different use elements.

Table_Apx B-1. Example COU: Lifecycle, Category, and Subcategory

Lifecycle	Category	Subcategory	Source
Lifecycle	*Type of Process or Use Operation*	*Function Category in: Industrial Sector*	*(U.S. EPA, 2019a)*
Processing	Incorporation into a formulation, mixture, or reaction product	Paint additives and coating additives not described by other categories in: Paint and coating manufacturing; and Plastic material and resin manufacturing	(U.S. EPA, 2019a)

ISs with Multiple Applicable COUs

An industrial sector may be listed under multiple COUs (Table_Apx B-2), this suggests industries are likely to use formaldehyde for different uses within one industrial sector. These COUs may all occur at one site, usually in different areas within a plant but inclusive of the total site-specific release amounts reported. It is also possible that within one industrial sector, there could be sites that are only applicable to one of the COUs tagged for that industrial sector. For the formaldehyde draft risk evaluation, most industrial sectors correspond to multiple COUs.

Table_Apx B-2. Example of a Multiple Crosswalk between an IS, COUs, and NAICS Codes

Industrial Sector	Applicable COUs (Lifecycle-Category-Subcategory)	NAICS Code Mapping
Plastic material and resin manufacturing (IS 22)	Processing-Reactant-Intermediate in: Pesticide, fertilizer, and other agricultural chemical manufacturing; Petrochemical manufacturing; Soap, cleaning compound, and toilet preparation manufacturing; All other basic organic chemical manufacturing; Plastic materials and resin manufacturing; Adhesive manufacturing; All other chemical product and preparation manufacturing; Paper manufacturing; Plastic products manufacturing; Wood product manufacturing; Construction; Agriculture, forestry, fishing, and hunting	All sites with Primary NAICS code of 325211 Plastic material and resin manufacturing
	Processing- Incorporation into article- Adhesives and sealant chemicals in wood product manufacturing; plastic material and resin manufacturing (including structural and fireworthy aerospace interiors); construction (including roofing materials); paper manufacturing	
	Processing- Incorporation into a formulation, mixture, or reaction product- Paint additives and	

Industrial Sector	Applicable COUs (Lifecycle-Category-Subcategory)	NAICS Code Mapping
	coating additives not described by other categories in: paint and coating manufacturing and plastic material and resin manufacturing	
	Processing- Incorporation into a formulation, mixture, or reaction product- Intermediate in: all other basic chemical manufacturing; all other chemical product and preparation manufacturing; plastic material and resin manufacturing; oil and gas drilling, extraction, and support activities; wholesale and retail trade	
	Processing- Incorporation into a formulation, mixture, or reaction product- Surface active agents in plastic material and resin manufacturing	

IS with only one corresponding COU

An industrial sector may be listed under one COU (Table_Apx B-3), this suggests industries are likely to use formaldehyde for one use within the industrial sector.

Table_Apx B-3. Example of a Single Crosswalk between an IS, COU, and NAICS Ccodes

Industrial Sector	Applicable COUs (Lifecycle-Category-Subcategory)	NAICS Code Mapping
Transportation Equipment Manufacturing	Paint additives and coating additives not described by other categories in transportation equipment manufacturing (including aerospace)	All sites under the NAICS code of 336 (Subsector) which includes sites reporting the following 6-digit codes: 336360 Motor Vehicle Seating and Interior Trim Manufacturing; 336413 Other Aircraft Parts and Auxiliary Equipment Manufacturing; 336111 Automobile Manufacturing; 336112 Light Truck and Utility Vehicle Manufacturing; and 336310 Motor Vehicle Gasoline Engine and Engine Parts Manufacturing

B.2 NAICS to CDR IS Crosswalk

Table_Apx B-4 provides the crosswalk between NAICS code and IS codes, which is then used for the crosswalk to COUs. EPA utilize this industrial sector mapping approach which solely utilizes the primary NAICS codes to efficiently map site-specific data from TRI and NEI to COUs.

Table_Apx B-4. NAICS to CDR IS Crosswalk

NAICS	IS Code	IS Title
11	IS1	Agriculture, Forestry, Fishing and Hunting
211	IS2	Oil and Gas Drilling, Extraction, and Support Activities
213		
212	IS3	Mining (except Oil and Gas) and Support Activities
22	IS4	Utilities
23	IS5	Construction
311	IS6	Food, beverage, and tobacco manufacturing
312	IS7	Textiles, apparel, and leather manufacturing
313		
314		
315		
316		
321	IS8	Wood Product Manufacturing
322	IS9	Paper Manufacturing
323	IS10	Printing and Related Support Activities
32411	IS11	Petroleum Refineries
32412	IS12	Asphalt Paving, Roofing, and Coating Manufacturing
324191	IS13	Petroleum Lubricating Oil and Grease Manufacturing
324199	IS14	All Other Petroleum and Coal Products Manufacturing
32511	IS15	Petrochemical Manufacturing
32512	IS16	Industrial Gas Manufacturing
32513	IS17	Synthetic Dye and Pigment Manufacturing
325182	IS18	Carbon Black Manufacturing
32518	IS19	All Other Basic Inorganic Chemical Manufacturing
325192	IS20	Cyclic Crude and Intermediate Manufacturing
32519	IS21	All Other Basic Organic Chemical Manufacturing
325211	IS22	Plastic Material and Resin Manufacturing
325212	IS23	Synthetic Rubber Manufacturing
32522	IS24	Organic Fiber Manufacturing
3253	IS25	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing

NAICS	IS Code	IS Title
3254	IS26	Pharmaceutical and Medicine Manufacturing
32551	IS27	Paint and Coating Manufacturing
32552	IS28	Adhesive Manufacturing
3256	IS29	Soap, Cleaning Compound, Toilet Preparation Manufacturing
32591	IS30	Printing Ink Manufacturing
32592	IS31	Explosives Manufacturing
325991	IS32	Custom Compounding of Purchased Resin
325992	IS33	Photographic Film Paper, Plate, and Chemical Manufacturing
325998	IS34	All Other Chemical Product and Preparation Manufacturing
3261	IS35	Plastics Product Manufacturing
3262	IS36	Rubber Product Manufacturing
327	IS37	Nonmetallic Mineral Product Manufacturing (includes clay, glass, cement, concrete, lime, gypsum, and other nonmetallic mineral product manufacturing)
331	IS38	Primary Metal Manufacturing
332	IS39	Fabricated Metal Product Manufacturing
333	IS40	Machinery Manufacturing
334	IS41	Computer and Electrical Product Manufacturing
335	IS42	Electrical Equipment, Appliance, and Component Manufacturing
336	IS43	Transportation Equipment Manufacturing
337	IS44	Furniture and Related Product Manufacturing
339	IS45	Miscellaneous Manufacturing
42	IS46	Wholesale and Retail Trade
44		
45		
48		
49		
51	IS47	Services
52		
53		
54		
55		
56		
61		
62		
71		

NAICS	IS Code	IS Title
72		
81		
92		
Taken from: Table D-2., Instructions for Reporting 2020 TSCA CDR		

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Appendix C CROSSWALK OF COUS TO APPLICABLE INDUSTRIAL SECTOR RELEASE ANALYSIS

Table_Apx C-1. Crosswalk of COUs to Applicable Industrial Sector Release Analysis

Condition of Use (COU)			Applicable Industrial Sector (IS) Release Analysis
Life Cycle Stage	**Category**	**Subcategory**	
Manufacturing	Domestic Manufacturing	Domestic Manufacturing	Domestic Manufacturing
	Importing	Importing	Wholesale and Retail Trade (IS15)[a]
Processing	Reactant	Adhesives and sealant chemicals in: Plastic and resin manufacturing; Wood product manufacturing; Paint and coating manufacturing; All other basic organic chemical manufacturing	Plastic material and resin manufacturing (IS22)
			Wood product manufacturing (IS08)
			Paint and coating manufacturing (IS27)
			All other basic organic chemical manufacturing (IS21)
Processing	Reactant	Intermediate in: Pesticide, fertilizer, and other agricultural chemical manufacturing; Petrochemical manufacturing; Soap, cleaning compound, and toilet preparation manufacturing; All other basic organic chemical manufacturing; Plastic materials and resin manufacturing; Adhesive manufacturing; All other chemical product and preparation manufacturing; Paper manufacturing; Paint and coating manufacturing; Plastic products manufacturing; Synthetic rubber manufacturing; Wood product	Pesticide, fertilizer, and other agricultural chemical manufacturing (IS25)
			Petrochemical manufacturing (IS15)
			Soap, cleaning compound, and toilet preparation manufacturing (IS29)
			All other basic organic chemical manufacturing (IS21)
			Plastic materials and resin manufacturing (IS22)
			Adhesive manufacturing (IS28)
			All other chemical product and preparation manufacturing (IS34)

Condition of Use (COU)			Applicable Industrial Sector (IS) Release Analysis
Life Cycle Stage	**Category**	**Subcategory**	
		manufacturing; Construction; Agriculture, forestry, fishing, and hunting	Paper manufacturing (IS9)
			Paint and coating manufacturing (IS27)
			Plastic product manufacturing (IS35)
			Synthetic rubber manufacturing (IS23)
			Wood product manufacturing (IS08)
			Construction (IS5)
			Agriculture, forestry, fishing, and hunting (IS1)
			Custom Compounding of Purchased Resin[b]
			Explosives Manufacturing[b]
			Fabricated Metal Product Manufacturing[b]
			Synthetic Dye and Pigment Manufacturing[b]
			Industrial Gas Manufacturing[b]
			Nonmetallic Mineral Product Manufacturing[b]
			Primary Metal Manufacturing[b]
Processing	Reactant	Functional fluid in: Oil and gas drilling, extraction, and support activities	Oil and gas drilling, extraction, and support activities (IS02)
Processing	Reactant	Processing aids, specific to petroleum production in all other basic chemical manufacturing	All other basic chemical manufacturing (IS21)

Condition of Use (COU)			Applicable Industrial Sector (IS) Release Analysis
Life Cycle Stage	**Category**	**Subcategory**	
Processing	Reactant	Bleaching agent in wood product manufacturing	Wood product manufacturing (IS08)
Processing	Reactant	Agricultural chemicals in agriculture, forestry, fishing, and hunting	Agriculture, forestry, fishing, and hunting (IS01)
Processing	Incorporation into an article	Finishing agents in textiles, apparel, and leather manufacturing	Textiles, apparel, and leather manufacturing (IS07)
Processing	Incorporation into an article	Paint additives and coating additives not described by other categories in transportation equipment manufacturing (including aerospace)	Transportation equipment manufacturing (IS43)
Processing	Incorporation into an article	Additive in rubber product manufacturing	Rubber Product Manufacturing (IS36)
Processing	Incorporation into an article	Adhesives and sealant chemicals in wood product manufacturing; plastic material and resin manufacturing (including structural and fireworthy aerospace interiors); construction (including roofing materials); paper manufacturing	Wood Product Manufacturing (IS08)
			Plastic Material and Resin manufacturing (IS22)
			Construction (IS05)
			Nonmetallic Mineral Product Manufacturing
			Paper Manufacturing (IS09)
	Incorporation into a formulation, mixture, or reaction product	Petrochemical manufacturing, petroleum, lubricating oil and grease manufacturing; fuel and fuel additives; lubricant and	Petrochemical manufacturing (IS15)
			Petroleum, lubricating oil and grease manufacturing (IS13)

Condition of Use (COU)			Applicable Industrial Sector (IS) Release Analysis
Life Cycle Stage	**Category**	**Subcategory**	
Processing		lubricant additives; all other basic organic chemical manufacturing; all other petroleum and coal products manufacturing	All other basic organic chemical manufacturing (IS21)
			All other petroleum and coal products manufacturing (IS14)
			Machinery Manufacturing[b]
			Synthetic Dye and Pigment Manufacturing[b]
			Printing Ink Manufacturing[b]
	Incorporation into a formulation, mixture, or reaction product	Asphalt, paving, roofing, and coating materials manufacturing	Asphalt, paving, roofing, and coating materials manufacturing (IS12)
	Incorporation into a formulation, mixture, or reaction product	Solvents (which become part of a product formulation or mixture) in paint and coating manufacturing	Paint and coating manufacturing (IS27)
	Incorporation into a formulation, mixture, or reaction product	Processing aids, specific to petroleum production in: oil and gas drilling, extraction, and support activities; all other chemical product and preparation manufacturing; and all other basic inorganic chemical manufacturing	Oil and gas drilling, extraction, and support activities (IS02)
			All other chemical product and preparation manufacturing (IS34)
			All other basic inorganic chemical manufacturing (IS19)
	Incorporation into a formulation, mixture, or reaction product	Paint additives and coating additives not described by other categories in: Paint and coating manufacturing; Plastic material and resin manufacturing	Paint and coating manufacturing (IS27)
			Plastic material and resin manufacturing (IS22)
	Incorporation into a formulation, mixture, or reaction product	Intermediate in: all other basic chemical manufacturing; all other chemical product and preparation manufacturing; plastic material and resin manufacturing; oil and gas drilling, extraction, and	All other basic organic chemical manufacturing (IS21)
			All other chemical product and preparation manufacturing (IS34)
			Plastic material and resin manufacturing (IS22)

Condition of Use (COU)			Applicable Industrial Sector (IS) Release Analysis
Life Cycle Stage	**Category**	**Subcategory**	
Processing		support activities; wholesale and retail trade	Oil and gas drilling, extraction, and support activities (IS02)
			Wholesale and retail trade (IS46)
			Custom Compounding of Purchased Resin[b]
			Nonmetallic Mineral Product Manufacturing[b]
			Fabricated Metal Product Manufacturing[b]
	Incorporation into a formulation, mixture, or reaction product	Solid separation agents in miscellaneous manufacturing	Miscellaneous manufacturing (IS45)
	Incorporation into a formulation, mixture, or reaction product	Agricultural chemicals (nonpesticidal) in: Agriculture, forestry, fishing, and hunting; pesticide, fertilizer, and other agricultural chemical manufacturing	Agriculture, forestry, fishing, and hunting (IS01)
			Pesticide, fertilizer, and other agricultural chemical manufacturing (IS25)
	Incorporation into a formulation, mixture, or reaction product	Surface active agents in plastic material and resin manufacturing	Plastic material and resin manufacturing (IS22)
	Incorporation into a formulation, mixture, or reaction product	Ion exchange agents in adhesive manufacturing and paint and coating manufacturing	Adhesive manufacturing (IS28)
			Paint and coating manufacturing (IS27)
	Incorporation into a formulation, mixture, or reaction product	Lubricant and lubricant additive in adhesive manufacturing	Adhesive manufacturing (IS28)
	Incorporation into a formulation, mixture, or reaction product	Plating agents and surface treating agents in all other chemical product and preparation manufacturing	All other chemical product and preparation manufacturing (IS34)

Condition of Use (COU)			Applicable Industrial Sector (IS) Release Analysis
Life Cycle Stage	**Category**	**Subcategory**	
Processing	Incorporation into a formulation, mixture, or reaction product	Soap, cleaning compound, and toilet preparation manufacturing	Soap, cleaning compound, and toilet preparation manufacturing (IS29)
	Incorporation into a formulation, mixture, or reaction product	Other: Laboratory chemicals	All other chemical product and preparation manufacturing (IS34)[a]
	Incorporation into a formulation, mixture, or reaction product	Adhesive and sealant chemical in adhesive manufacturing	Adhesive manufacturing (IS28)
	Incorporation into a formulation, mixture, or reaction product	Bleaching agents in textile, apparel, and leather manufacturing	Textile, apparel, and leather manufacturing (IS07)
	Repackaging	Sales to distributors for laboratory chemicals	Wholesale and Retail Trade (IS15)
	Recycling	Recycling	Plastics Product Manufacturing[a]
			Paper Manufacturing[a]
			Wood Product Manufacturing[a]
Distribution	Distribution	Distribution in Commerce	N/A
Industrial Use	Non-incorporative activities	Process aid in: Oil and gas drilling, extraction, and support activities; process aid specific to petroleum production, hydraulic fracturing	Oil and gas drilling, extraction, and support activities (IS02)
Industrial Use	Non-incorporative activities	Used in: construction	Construction (IS05)
			Furniture and related Manufacturing[b]
Industrial Use	Non-incorporative activities	Oxidizing/reducing agent; processing aids, not otherwise listed (*e.g.*, electroless copper plating)	Computer and Electronic Product Manufacturing (IS41)[a]
			Fabricated Metal Product Manufacturing[b]
			Organic Fiber Manufacturing[b]

Condition of Use (COU)			Applicable Industrial Sector (IS) Release Analysis
Life Cycle Stage	**Category**	**Subcategory**	
Industrial Use	Chemical substances in industrial products	Paints and coatings; adhesives and sealants; lubricants	Transportation equipment manufacturing (IS43)[a]
			Fabricated Metal Product Manufacturing[b]
			Furniture and related product manufacturing[b]
			Electrical Equipment, Appliance, and Component Manufacturing[b]
			Primary Metal Manufacturing[b]
Disposal	Disposal	Disposal	Services (IS47)
			Industrial Gas Manufacturing[b]

[a] An industrial sector is not directly specified for the COU, therefore, EPA assigned an appropriate industrial sector.
[b] This industrial sector was reported but is not included in the sectors in the COU, therefore, EPA assigned an appropriate COU.

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Appendix D SUMMARY OF ENVIRONMENTAL RELEASES

D.1 Annual Land Releases from TRI

Most formaldehyde waste is expected via land disposal methods, as reported in TRI. Table_Apx D-1 provides a breakdown of the annual amounts of formaldehyde disposed per land disposal method. The most significant method of land disposal of formaldehyde is via underground injection with 22 sites disposing of more than 5 million kilograms of formaldehyde annually. The industries with the largest land releases per site were Manufacturing of Formaldehyde, Pesticide and Other Agricultural Manufacturing (expected to process formaldehyde as a reactant), All Other Basic Organic Chemical Manufacturing (expected to process formaldehyde as a reactant and into formulations), Plastics Materials and Resin Manufacturing (expected to process formaldehyde as a reactant, into formulations and articles), and Hazardous Waste Treatment and Disposal.

Table_Apx D-1.Total Annual Land Disposal for Formaldehyde Reported to TRI

Annual Reported Land Disposal (kg/yr-all sites) [a]							
Land Disposal Method[b]	**No. of Sites[c]**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Total Underground Injection, Class I	22	6,013,915	6,687,915	6,574,139	6,523,833	6,239,129	5,867,369
Total Underground Injection, Class II-V	2	0	0	0	0	0.1	4
Total RCRA Subtitle C Landfills	41	100,781	217,156	48,656	17,603	23,622	33,756
Total Other Landfills	159	322,736	183,381	123,908	132,413	106,426	93,592
Total Land Treatment	29	414	2,367	293	281	238	199
Total Surface Impoundments	15	744	728	428	429	12,289	72,399
Total Other Disposal	5	90	209	75	392	512	688
Total Transfer to Waste Broker	31	1,739	11,670	773	18,424	6,515	25,110
Total Solidification/ Stabilization	43	162,281	279,387	133,652	133,712	71,209	54,796
Sludge to Disposal	4	0	0	726	4,618	635	590
Sludge to Agricultural Applications	1	0	0	0	116	0	134

[a] Based on 2016–2021 TRI (U.S. EPA, 2022c)
[b] Total Land Disposal Method includes on-site and off-site
[c] Total Number of Unique Sites across 2016 through 2021 TRI data

D.2 Annual Water Releases from TRI and DMR

Only a small percentage of formaldehyde waste is expected to be directly released to surface water based on information reported to TRI. Most wastewater streams are transferred to publicly owned treatment works (POTW) or other wastewater treatment (WWT) plants, as detailed in Table_Apx D-2. The most common sites to have direct discharges were involved in Manufacturing of Formaldehyde, Paper Manufacturing, and Textiles, Apparel, and Leather Manufacturing. For indirect discharges through POTW or WWT, TRI data indicated sites reported as Manufacturing of Formaldehyde, Plastic Product Manufacturing, and Plastics Material and Resin Manufacturing transferred the largest amounts of formaldehyde waste to POTW or WWT. A significant number of fish hatcheries reported direct dischargers in DMR (U.S. EPA, 2022b). EPA expects that these discharges are likely from use of formalin as an animal drug. Therefore, these releases are not expected to be the result of a TSCA COU (*i.e.*, is subject to FDA jurisdiction) and are not considered further in this assessment.

Table_Apx D-2. Total Annual Water Discharges and Transfers to POTW or WWT Reported to TRI and DMR

Annual Reported Water Releases (kg/yr-all sites)							
TRI (Form R Only)							
Disposal Method	**No. of Sites[a]**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
On-Site	154	80,828	79,841	97,549	98,800	101,013	82,529
Transfer to POTW	122	458,686	464,375	497,110	490,549	532,151	518,721
Transfer to WWT (non-POTW)	46	1,509,619	1,625,443	1,575,348	1,418,185	1,503,770	1,778,724
DMR[b]							
On-Site	23	18,904	66,891	3,054	3,616	3,135	6,822

[a] Total Number of Unique Sites across 2016 through 2021 TRI data (U.S. EPA, 2022c)
[b] Does not include DMR (U.S. EPA, 2022b) data reported by fish hatcheries. EPA has determined, after consultation with FDA, that the use of formalin as an animal drug (*i.e.*, to diagnose, cure, mitigate, treat, or prevent disease in animals or to affect the structure or function of animals [21 U.S.C. 321(g)(1)(B) & (C)]) to control external parasites on hatchery fish and their eggs is subject to FDA jurisdiction.

D.3 Annual Air Releases from TRI and NEI

Review of TRI and NEI shows that formaldehyde is primarily released to air via stack emissions, although this can vary between industries. EPA analysis showed Oil and Gas Drilling, Extraction, and Support Activities, Wholesale and Retail Trade and Wood Product Manufacturing, are among some of the highest emitters of formaldehyde to air. Section 2 provides a summary of the air emissions of formaldehyde into the environment.

714 **Table_Apx D-3. Total Annual Air Emissions Reported to TRI and NEI**

Annual Reported Air Emissions (kg/yr-all sites)							
TRI (Form R Only) [a]							
	No. of Sites[b]	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Fugitive Emissions	682	150,497	156,834	156,963	169,382	164,111	183,162
Stack Emissions	777	2,080,300	2,223,278	2,024,844	2,019,194	1,939,980	1,941,786
NEI[c]							
Fugitive Emissions	34,648	–	7,568,972	–	–	Not evaluated	–
Stack Emissions	17,352	–	17,869,243	–	–	Not evaluated	–

[a] Total air emissions of TRI Form R reporters that reported fugitive and/or stack emissions. Based on 2016-2021 TRI (U.S. EPA, 2022c) extracted October 2022.
[b] Total number of unique sites reported through 2016 to 2021 with nonzero emissions.
[c] NEI reporting occurs every 3 years. Included in this draft RE is 2017 NEI (U.S. EPA, 2019b).
[d] 2020 NEI data summaries were published March 30, 2023, and were not able to be incorporated into this draft risk evaluation.

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D.4 Air Release Estimates by Industrial Sector and COU

Table_Apx D-4. Summary of Air Emission Estimates for Each Industrial Sector

Lifecycle-Category (of COU)	Industrial Sector[a]	Number of Emission Records (non-zero)	Type of Air Emission	Median (kg/yr-site)	95th Percentile (kg/yr-site)	Source[a]
Domestic Manufacturing	Manufacturing	202	Fugitive	281	2,736	TRI
		212	Stack	1,153	10,645	TRI
		28	Fugitive	432	2,204	NEI
		34	Stack	1,534	10,227	NEI
Processing- Reactant-intermediate	Adhesive Manufacturing	7	Fugitive	2	65	TRI
Processing- Incorporation into a formulation, mixture, or reaction product- Ion exchange agents		9	Stack	91	455	TRI
Processing- Incorporation into a formulation, mixture, or reaction product- Lubricant and lubricant additive		16	Fugitive	1	56	NEI
Processing- Incorporation into a formulation, mixture, or reaction product- Adhesive and Sealant Chemicals		24	Stack	2	118	NEI
Processing-Reactant-Intermediate	Agriculture, Forestry, Fishing and Hunting	164	Fugitive	0.08	9	NEI
Processing-Reactant-Agricultural Chemicals		61	Stack	1	213	NEI
Processing- Incorporation into a formulation, mixture, or reaction product- Agricultural chemicals (Nonpesticidal)						
Processing- Incorporation into a formulation, mixture, or reaction product- Processing aids, specific to petroleum production	All Other Basic Inorganic Chemical Manufacturing	11	Fugitive	16	33	TRI
		24	Stack	230	4,562	TRI
		27	Fugitive	0.34	11	NEI
		100	Stack	4	364	NEI
Processing-Reactant-Adhesive and Sealant Chemicals	All Other Basic Organic Chemical Manufacturing	789	Fugitive	10	289	TRI

Lifecycle-Category (of COU)	Industrial Sector[a]	Number of Emission Records (non-zero)	Type of Air Emission	Median (kg/yr-site)	95th Percentile (kg/yr-site)	Source[a]
Processing-Reactant- Processing aids, specific to petroleum production						
Processing-Reactant-Intermediate		867	Stack	395	1,975	TRI
Processing- Incorporation into a formulation, mixture, or reaction product		129	Fugitive	4	673	NEI
		279	Stack	48	1,541	NEI
Processing-Reactant- Intermediate	All Other Chemical Product and Preparation Manufacturing	155	Fugitive	21	316	TRI
Processing- Incorporation into a formulation, mixture, or reaction product- Processing aids, specific to petroleum production		166	Stack	43	990	TRI
Processing- Incorporation into a formulation, mixture, or reaction product- Intermediate		42	Fugitive	5	220	NEI
Processing- Incorporation into a formulation, mixture, or reaction product- Other: Laboratory Chemicals		112	Stack	6	807	NEI
Processing- Incorporation into a formulation, mixture, or reaction product- Plating agents and surface treating agents						
Processing- Incorporation into a formulation, mixture, or reaction product	All Other Petroleum and Coal Products Manufacturing	14	Fugitive	2	899	NEI
		25	Stack	2	455	NEI
Processing- Incorporation into a formulation, mixture, or reaction product	Asphalt, Paving, Roofing, and Coating Materials Manufacturing	7	Fugitive	91	526	TRI
		13	Stack	738	1,433	TRI
		279	Fugitive	3	248	NEI
		630	Stack	98	639	NEI
Industrial Use- Non-incorporative activities- Oxidizing/reducing agent; processing aids, not otherwise listed (e.g., electroless copper plating	Computer and Electronic Product Manufacturing	266	Fugitive	0.01	7.2	NEI
		118	Stack	2	61	NEI
Processing-Reactant- Intermediate	Construction	7[b]	Fugitive	91	526	TRI

Lifecycle-Category (of COU)	Industrial Sector[a]	Number of Emission Records (non-zero)	Type of Air Emission	Median (kg/yr-site)	95th Percentile (kg/yr-site)	Source[a]
		13	Stack	738[b]	1,433[b]	TRI
Processing-Incorporation into Article- Adhesive and Sealants		148	Fugitive	0.005	68	NEI
Industrial Use- Non-incorporative activities		57	Stack	1	675	NEI
Processing as a reactant-Intermediate	Custom Compounding of Purchased Resin[a]	9	Fugitive	49	321	TRI
		9	Stack	58	560	TRI
Processing-Incorporation into a formulation, mixture, or reaction product		11	Fugitive	0.13	1.58	NEI
		17	Stack	0.26	75	NEI
Industrial Use-Chemical substances in industrial products- Paints and coatings; adhesives and sealants; lubricants	Electrical Equipment, Appliance, and Component Manufacturing[a]	71	Fugitive	0.09	10	NEI
		82	Stack	1	99	NEI
Processing as a reactant-Intermediate	Explosives Manufacturing[a]	2	Fugitive	98	185	TRI
		5	Stack	7	33	TRI
Processing as a reactant-Intermediate	Fabricated Metal Product Manufacturing[a]	101	Fugitive	10	132	TRI
Processing-Incorporation into a formulation, mixture, or reaction product- Intermediate		141	Stack	219	2,858	TRI
Industrial Use- Non-incorporative activities- Oxidizing/reducing agent, processing aids, not otherwise listed (e.g., electroless copper plating)		426	Fugitive	0.09	22	NEI
Industrial Use-Chemical substances in industrial products- Paints and coatings; adhesives and sealants; lubricants		571	Stack	1	216	NEI
Industrial Use- Non-incorporative activities- used in: construction	Furniture and Related Product Manufacturing[a]	8	Fugitive	7	3,917	TRI
		14	Stack	159	468	TRI
Industrial Use-Chemical substances in industrial products- Paints and coatings; adhesives and sealants; lubricants		110	Fugitive	0.41	148	NEI
		263	Stack	6	292	NEI

Lifecycle-Category (of COU)	Industrial Sector[a]	Number of Emission Records (non-zero)	Type of Air Emission	Median (kg/yr-site)	95th Percentile (kg/yr-site)	Source[a]
Processing as a reactant-Intermediate	Industrial Gas Manufacturing[a]	3	Fugitive	1	4	TRI
		6	Stack	350	468	TRI
Disposal		16	Fugitive	2	192	NEI
		38	Stack	12	615	NEI
Processing- Incorporation into a formulation, mixture, or reaction product	Machinery Manufacturing[a]	6	Fugitive	220	2,611	TRI
		8	Stack	2,165	10,424	TRI
		102	Fugitive	0.07	53	NEI
		242	Stack	0.76	95	NEI
Processing- Incorporation into a formulation, mixture, or reaction product- Solid separation agents	Miscellaneous Manufacturing	9	Fugitive	244	340	TRI
		20	Stack	19,065	31,651	TRI
		107	Fugitive	0.04	7	NEI
		102	Stack	1	146	NEI
Processing as a reactant-Intermediate	Nonmetallic Mineral Product Manufacturing[a]	131	Fugitive	113	8,407	TRI
Processing-Incorporation into an article-Adhesives and sealant chemicals		178	Stack	3,259	27,961	TRI
		207	Fugitive	0.44	263	NEI
Processing- Incorporation into a formulation, mixture, or reaction product- Intermediate		527	Stack	1	4858	NEI
Processing-Reactant- Functional fluid	Oil and Gas Drilling, Extraction, and Support Activities	696	Fugitive	71	4,117	NEI
Processing- Incorporation into a formulation, mixture, or reaction product- Processing aids, specific to petroleum production						
Processing- Incorporation into a formulation, mixture, or reaction product- Intermediate		2486	Stack	630	7,265	NEI
Industrial Use- Non-incorporative activities-Processing aids						
		6	Fugitive	181	362	TRI

Lifecycle-Category (of COU)	Industrial Sector[a]	Number of Emission Records (non-zero)	Type of Air Emission	Median (kg/yr-site)	95th Percentile (kg/yr-site)	Source[a]
Industrial Use- Non-incorporative activities- Oxidizing/reducing agent, processing aids, not otherwise listed (e.g., electroless copper plating)	Organic Fiber Manufacturing[a]	4	Fugitive	0.29	152	NEI
		16	Stack	28	2,147	NEI
Processing-Reactant- Adhesive and Sealant Chemicals	Paint and Coating Manufacturing	28	Fugitive	17	2,948	TRI
Processing-Reactant- Intermediate		25	Stack	233	969	TRI
Processing- Incorporation into a formulation, mixture, or reaction product- Solvents (which become part of a product formulation or mixture)		33	Fugitive	0.716	239	NEI
Processing- Incorporation into a formulation, mixture, or reaction product- Paint additives and coating additives not described by other categories		57	Stack	1	205	NEI
Processing- Incorporation into a formulation, mixture, or reaction product- Ion exchange agents						
Processing- Reactant- Intermediate	Paper Manufacturing	567	Fugitive	20	323	TRI
Recycling						
Processing-Incorporation into Article- Adhesive and Sealants		621	Stack	4,309	13,502	TRI
		249	Fugitive	7	1,642	NEI
		417	Stack	25	7,773	NEI
Processing- Reactant- Intermediate	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	129	Fugitive	118	1,852	TRI
Processing- Incorporation into a formulation, mixture, or reaction product- Agricultural chemicals (Nonpesticidal)		143	Stack	227	6,473	TRI
		45	Fugitive	0.09	678	NEI
		71	Stack	15	1,351	NEI
Processing- Reactant- Intermediate	Petrochemical Manufacturing	31	Fugitive	7	2,177	TRI
		52	Stack	544	13,637	TRI
		39	Fugitive	5	609	NEI

Lifecycle-Category (of COU)	Industrial Sector[a]	Number of Emission Records (non-zero)	Type of Air Emission	Median (kg/yr-site)	95th Percentile (kg/yr-site)	Source[a]
Processing- Incorporation into a formulation, mixture, or reaction product		94	Stack	22	4,900	NEI
Processing- Incorporation into a formulation, mixture, or reaction product	Petroleum Lubricating Oil and Grease Manufacturing	7	Fugitive	3	8	NEI
		20	Stack	2	24	NEI
Processing-Reactant-Adhesives and Sealants	Plastic Material and Resin Manufacturing	155	Fugitive	23	958	TRI
Processing-Reactant-Intermediate		185	Stack	155	4,775	TRI
Processing- Incorporation into a formulation, mixture, or reaction product- Paint additives and coating additives not described by other categories						
Processing- Incorporation into a formulation, mixture, or reaction product- Intermediate		74	Fugitive	2	530	NEI
Processing- Incorporation into a formulation, mixture, or reaction product- Surface Active Agents		156	Stack	9	1,639	NEI
Processing-Incorporation into Article- Adhesive and Sealants						
Processing-Reactant-Intermediate	Plastics Product Manufacturing	41	Fugitive	254	2,983	TRI
		54	Stack	616	8,024	TRI
Recycling		157	Fugitive	0.27	35	NEI
		269	Stack	1	176	NEI
Processing-Reactant-Intermediate	Primary Metal Manufacturing[a]	27	Fugitive	2	97	TRI
		33	Stack	48	1,629	TRI
Industrial Use- Non-incorporative activities- Oxidizing/reducing agent, processing aids, not otherwise listed (e.g., electroless copper plating)		250	Fugitive	2	101	NEI
		405	Stack	4	536	NEI
		3	Fugitive	0.34	0.44	NEI

Lifecycle-Category (of COU)	Industrial Sector[a]	Number of Emission Records (non-zero)	Type of Air Emission	Median (kg/yr-site)	95th Percentile (kg/yr-site)	Source[a]
Processing- Incorporation into a formulation, mixture, or reaction product	Printing Ink Manufacturing[a]	9	Stack	0.5	4	NEI
Processing- Incorporation into Article-Additive	Rubber Product Manufacturing	3	Stack	1.5E−4	2	TRI
		38	Fugitive	0.20	7	NEI
		103	Stack	3	40	NEI
Processing-Reactant-Intermediate	Soap, Cleaning Compound, and Toilet Preparation Manufacturing	65	Fugitive	5	1,162	TRI
Processing- Incorporation into a formulation, mixture, or reaction product		74	Stack	45	884	TRI
		35	Fugitive	0.28	24	NEI
		53	Stack	2	299	NEI
Processing-Reactant-Intermediate	Synthetic Dye and Pigment Manufacturing[a]	14	Fugitive	113	296	TRI
		13	Stack	4	1,342	TRI
Processing- Incorporation into a formulation, mixture, or reaction product		10	Fugitive	1	2,889	NEI
		29	Stack	5	174	NEI
Processing-Reactant-Intermediate	Synthetic Rubber Manufacturing	3	Fugitive	0.07	3	NEI
		19	Stack	11	482	NEI
Processing- Incorporation into Article-Finishing Agents	Textiles, apparel, and leather manufacturing	49	Fugitive	22	8,042	TRI
		66	Stack	577	3,315	TRI
Processing- Incorporation into a formulation, mixture, or reaction product-Bleaching Agents		96	Fugitive	0.47	318	NEI
		157	Stack	4	717	NEI
Processing-Incorporation into an Article- Paint additives and coating additives	Transportation Equipment Manufacturing	25	Fugitive	44	3,146	TRI
		31	Stack	8,873	40,823	TRI
Industrial Use-Chemical substances in industrial products- Paints and coatings; adhesives and sealants, lubricants		286	Fugitive	0.42	41	NEI
		361	Stack	2	617	NEI
Manufacturing- Importing	Wholesale and Retail Trade	41	Fugitive	2	238	TRI

Lifecycle-Category (of COU)	Industrial Sector[a]	Number of Emission Records (non-zero)	Type of Air Emission	Median (kg/yr-site)	95th Percentile (kg/yr-site)	Source[a]
Processing-Incorporation into a formulation, mixture, or reaction product-Intermediate		33	Stack	6	340	TRI
Processing-Repackaging		21,562	Fugitive	1	546	NEI
		2,043	Stack	169	9,345	NEI
Processing-Reactant-Adhesives and Sealants	Wood Product Manufacturing	292	Fugitive	272	1,520	TRI
Processing-Reactant-Intermediate		409	Stack	5,664	24,724	TRI
Processing-Reactant-Bleaching Agent		291	Fugitive	159	3,807	NEI
Processing-Incorporation into Article- Adhesive and Sealants		530	Stack	300	7,960	NEI
Recycling						
Disposal (Services industrial sector includes waste management industry)	Services	73	Fugitive	25	524	TRI
		62	Stack	0.45	361	TRI
		5,882	Fugitive	0.006	8	NEI
		2,551	Stack	1	112	NEI

Note: Reporting years between 2016 to 2021 for TRI (U.S. EPA, 2022c) and 2017 NEI (U.S. EPA, 2019b). TRI has a data quality rating of high and NEI has a data quality rating of high.

[a]Industrial sectors not included in the listed sectors for this COU. EPA used professional judgement and some meta-data from the TRI database to assign to an 'applicable' COU. EPA did not assign a COU to Food, beverage, and tobacco manufacturing and the pharmaceutical and medicine manufacturing, as these sectors could potentially be due to non-TSCA activites. All sectors are included in the Formaldehyde Supplemental Information File: Air Release Summary and Statistics for NEI and TRI.

[b] Additional meta-data in the COU table for construction lists roofing, therefore TRI data from Asphalt, Paving, Roofing, and Coating Materials Manufacturing was included as a possible applicable industrial sector for that COU.

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D.5 Air Release Estimates by Commercial COU

Table_Apx D-5. Summary of Air Emission Estimates for Each Commercial COUs

COU	Expected Type of Air Release	Range of Air Emissions Annually (kg/yr-site)	Basis
Commercial Use- Chemical Substances in furnishing treatment/care products- Floor Coverings; Foam seating and bedding products; Furniture and furnishings not covered elsewhere; Cleaning and furniture care products; Fabric, textile, and leather products not covered elsewhere	Emissions from installation and demolition of floor coverings, furniture and furnishings, wood products, and other building products	2.5E−05 to 198 (Fugitive) 1 to 1,883 (11,047) (Stack)	Grouped COU with the NEI Industrial sector of Construction
	Fugitive emissions from off-gassing from foam, floor coverings, fabric, textile, and leather products	EPA covers the off gassing from articles within the Indoor Air Assessment	
Commercial Use- Chemical Substances in treatment products- Water treatment products Commercial Use- Chemical substances in treatment/care products- Laundry and dishwashing products	EPA did not find relevant or surrogate TRI or NEI data, sufficient chemical concentration, or production volume information to sufficiently estimate air emissions for these COUs. Therefore, EPA was not able to estimate air emissions for these COUs.		
Commercial Use- Chemical substances in construction, paint, electrical, and metal products- Adhesives and Sealants; Paint and coatings	Fugitive Emissions	2.5E−05 to 198 (Fugitive)	Grouped COU with the NEI Industrial sector of Construction
	Stack Emissions	1 to 1,883 (11,047) (Stack)	
Commercial Use- Chemical substances in furnishing treatment/care products- Building/construction materials – wood and engineered wood products; Building/ construction materials not covered elsewhere	Fugitive Emissions	2.5E−05 to 198 (Fugitive)	Grouped COU with the NEI Industrial sector of Construction
	Stack Emissions	1 to 1,883 (11,047) (Stack)	

COU	Expected Type of Air Release	Range of Air Emissions Annually (kg/yr-site)	Basis
Commercial Use- Chemical substances in electrical products- Electrical and electronic products	Fugitive Emissions	2.0E−07 to 117	Grouped COU with the NEI Industrial sector of Electrical Equipment, Appliance, and Component Manufacturing
	Stack Emissions	2.9E−03 to 1,594	
Commercial Use- Chemical substances in metal products- Metal products not covered elsewhere	Fugitive Emissions	4.5E−05 to 170 (TRI) 2.7E−08 TO 4445 (NEI)	Grouped COU with the TRI & NEI Industrial sector of Fabricated Metal Product Manufacturing
	Stack Emissions	4.5E−04 to 28,360 (TRI) 2.7E−07 TO 10,472 (NEI)	
Commercial Use- Chemical substances in automotive and fuel products- Automotive care products; Lubricants and greases; Fuels and related products	Fugitive & Stack Emissions	<1 Fugitive <20 Stack (Automotive Care Products & Lubricants and greases) 3E−07 to 10,108 Fugitive 8.5E−08 to 101,968 Stack	Specific NAICS codes (Automotive Care Products & Lubricants and greases) Utilities (Fuel and related products)
Commercial Use- Chemical substances in agriculture use products- Lawn and garden products	Fugitive Emissions	0.08 to 9	Grouped COU with the NEI Agriculture, Forestry, Fishing and Hunting
	Stack Emissions	1 to 213	
Commercial Use- Chemical substances in outdoor use products- Explosive materials	EPA expects the concentration of formaldehyde within these products to be low (<1%), the application/use of the products at one site is likely to not be a continuous activity, and EPA did not identify a suitable surrogate industrial sector. EPA did identify emission factors for pyrotechnics, which indicated low emissions (<~80 mg/kg device). EPA has limited use information for other type of explosive materials. Therefore, EPA could not estimate the air emissions from these uses but expected it to be low.		
Commercial Use- Chemical substances in packaging, paper, plastic, hobby products- Paper products; Plastic and rubber products; Toys, playground, and sporting equipment	Fugitive Emissions	2.7E−08 to 23	Grouped COUs with the NEI Industrial sector of Printing and Related Support Activities
	Stack Emissions	4.0E−04 to 480	

COU	Expected Type of Air Release	Range of Air Emissions Annually (kg/yr-site)	Basis
Commercial Use- Chemical substances in packaging, paper, plastic, hobby products- Arts, crafts, and hobby materials			
Commercial Use- Chemical substances in packaging, paper, plastic, hobby products- Ink, toner, and colorant products; Photographic supplies	Fugitive Emissions	2.7E−08 to 23 (Printing and Related Support Activities)	Grouped COUs with the NEI Industrial sector of Printing and Related Support Activities & Photographic Film Paper, Plate, and Chemical Manufacturing
	Stack Emissions	4.0E−04 to 480 (Printing and Related Support Activities)	
	Fugitive Emissions	0.54 to 48 (Photographic Film Paper, Plate, and Chemical Manufacturing)	
	Stack Emissions	0.19 to 56 (Photographic Film Paper, Plate, and Chemical Manufacturing)	
Commercial Use- Chemical substances in products not described by other codes- Other: Laboratory Chemicals (e.g., specimen preservation, medical samples, mortuary science)	EPA did not provide a quantitative estimate for air emissions but expects air emissions to be low based on estimated use rate (<314 kg used per site) (U.S. EPA, 2023), low production volume, and expected release points.		

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Appendix E NUMBER OF INDUSTRIAL AND COMMERCIAL FACILITIES

This appendix contains additional information relevant to the number of sites identified in TRI and NEI

E.1 Number of Industrial and Commercial Facilities with Reported Air Emissions

As part of the Environmental Release Assessment, EPA identified 811 TRI reporters and 49, 710 NEI reporters with nonzero air emissions of formaldehyde (Table_Apx E-1). EPA used 2016 to 2021 TRI (U.S. EPA, 2022c) and 2017 NEI (U.S. EPA, 2019b). These databases collectively are expected to account for industrial and commercial COUs. Each estimate is provided per industrial sector.

Table_Apx E-1. Number of Sites with Stack and/or Fugitive Air Emissions in TRI and NEI

Industrial Sector	Type of Release	Number of Facilities	Notes
Manufacturing of formaldehyde[a]	TRI	35	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	32	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Adhesive Manufacturing	TRI	3	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	36	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Agriculture, Forestry, Fishing, and Hunting	NEI	221	Based on 2017 NEI reporting (U.S. EPA, 2019b).
All Other Basic Inorganic Chemical Manufacturing	TRI	7	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	112	Based on 2017 NEI reporting (U.S. EPA, 2019b).
All Other Basic Organic Chemical Manufacturing	TRI	198	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	312	Based on 2017 NEI reporting (U.S. EPA, 2019b).
All Other Chemical Product Manufacturing	TRI	43	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	129	Based on 2017 NEI reporting (U.S. EPA, 2019b).
All Other Petroleum and Coal Products	NEI	37	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Asphalt, Paving, Roofing, and Coating Materials Manufacturing	TRI	3	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	819	Based on 2017 NEI reporting (U.S. EPA, 2019b).

Industrial Sector	Type of Release	Number of Facilities	Notes
Computer and Electronic Product Manufacturing	TRI	15	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	366	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Construction	NEI	199	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Custom Compounding of Purchased Resins	TRI	2	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	24	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Electrical Equipment, Appliance, and Component Manufacturing	NEI	111	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Explosives Manufacturing	NEI	7	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Fabricated Metal Manufacturing	TRI	35	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	924	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Food, Beverage and Tobacco Manufacturing	TRI	33	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	1,460	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Furniture Manufacturing	TRI	4	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	329	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Industrial Gas Manufacturing	TRI	1	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	53	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Machinery Manufacturing	TRI	3	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	320	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Mining (except oil and gas) and Support Activities	TRI	1	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	701	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Miscellaneous Manufacturing	TRI	5	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).

Industrial Sector	Type of Release	Number of Facilities	Notes
	NEI	199	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Nonmetallic Mineral Product Manufacturing	TRI	40	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	661	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Organic Fiber Manufacturing	TRI	1	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	16	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Oil and Gas Drilling, Extraction, and Support Activities	NEI	3,102	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Paint and Coating Manufacturing	TRI	9	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	78	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Paper Manufacturing	TRI	113	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	515	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	TRI	35	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	100	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Petrochemical Manufacturing	TRI	30	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	104	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Petroleum Lubricating Oil and Grease Manufacturing	NEI	26	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Petroleum Refineries	TRI	7	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	135	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Pharmaceutical and Medicine Manufacturing	TRI	7	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	206	Based on 2017 NEI reporting (U.S. EPA, 2019b).

Industrial Sector	Type of Release	Number of Facilities	Notes
Photographic Film Paper, Plate, and Chemical Manufacturing	NEI	11	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Plastic Material and Resin Manufacturing	TRI	37	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	195	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Plastics Product Manufacturing	TRI	11	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	392	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Primary Metal Manufacturing	TRI	8	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	532	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Printing and Related Support Activities	NEI	225	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Printing Ink Manufacturing	NEI	11	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Rubber Product Manufacturing	TRI	1	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	122	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Services	TRI	20	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	8,087	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Soap, Cleaning Compound, and Toilet Preparation Manufacturing	TRI	17	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	75	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Synthetic Dye and Pigment Manufacturing	TRI	4	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	36	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Synthetic Rubber Manufacturing	NEI	20	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Textiles, apparel, and leather manufacturing	TRI	14	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	213	Based on 2017 NEI reporting (U.S. EPA, 2019b).

Industrial Sector	Type of Release	Number of Facilities	Notes
Transportation Equipment Manufacturing	TRI	6	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	556	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Utilities	TRI	16	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	3,793	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Wholesale and Retail Trade	TRI	17	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	23,455	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Wood Product Manufacturing	TRI	85	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
	NEI	626	Based on 2017 NEI reporting (U.S. EPA, 2019b).
Total	**TRI**	**810**	Based on 2016–2021 TRI reporting (U.S. EPA, 2022c).
	NEI	**49, 710**	Based on 2017 NEI reporting (U.S. EPA, 2019b).

Note: Sites included are only sites in TRI and NEI with reported air emissions; TRI Form A reporters are not required to specify the amount of formldehyde released or release media, these sites were not considered in the industrial sector distribution. In addition, not all industrial sectors could be mapped to a TSCA COU.
[a] Manufacturing of Formaldehyde for TRI and NEI were manually modified based on the COU-Occupational Exposure Scenario (OES) mapping approach covered in the Formaldehyde Occupational Exposure Assessment Module. As part of developing a number of workers estimate, TRI and NEI data is used to assign sites to the OES whose activities best fit the exposure scenario assessed for potential workers. Sites assigned to this exposure scenario are expected to manufacture formaldehyde for the sale or processing/use of formaldehyde on site. It does not include sites that noted formaldehyde was only produced as a byproduct.

E.2 Number of Facilities with TRI Form A Submissions

As further discussed in Appendix F, each facility subject to the rule must report either using a Form R or a Form A. Facilities reporting using a Form R must report annually the volume of chemical released to the environment (*i.e.*, surface water, air, or land) and/or managed through recycling, energy recovery, and treatment (*e.g.*, incineration) from the facility. Facilities may submit a Form A if the volume of chemical manufactured, processed, or otherwise used does not exceed 1,000,000 pounds per year (lb/year) and the total annual reportable releases do not exceed 500 lb/year. Facilities reporting using a Form A are not required to submit annual release and waste management volumes or use/sub-use information for the chemical. Table_Apx E-2 provides the number of facilties that reported a form A site and their industrial sector. Of note, EPA reviewed a range of six years in which a site may have r

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Industrial Sector	Type of Release	Number of Facilities	Notes
Adhesive Manufacturing	TRI	4	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
Agriculture, Forestry, Fishing, and Hunting	TRI	1	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
All Other Basic Inorganic Chemical Manufacturing	TRI	2	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
All Other Basic Organic Chemical Manufacturing	TRI	28	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
All Other Chemical Product Manufacturing	TRI	20	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
Computer and Electronic Product Manufacturing	TRI	3	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
Custom Compounding of Purchased Resins	TRI	1	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
Food, Beverage and Tobacco Manufacturing	TRI	32	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
Nonmetallic Mineral Product Manufacturing	TRI	4	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
Paint and Coating Manufacturing	TRI	2	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	TRI	2	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
Plastic Material and Resin Manufacturing	TRI	5	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
Soap, Cleaning Compound, and Toilet Preparation Manufacturing	TRI	3	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
Synthetic Dye and Pigment Manufacturing	TRI	4	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
Textiles, apparel, and leather manufacturing	TRI	2	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).

Industrial Sector	Type of Release	Number of Facilities	Notes
Wholesale and Retail Trade	TRI	14	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
Wood Product Manufacturing	TRI	4	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).
Total	**TRI**	**131**	Based on 2016-2021 TRI reporting (U.S. EPA, 2022c).

Note: Sites included are only sites in TRI and NEI with reported air emissions; TRI Form A reporters are not required to specify the amount of formldehyde released or release media, these sites were not considered in the industrial sector distribution. In addition, not all industrial sectors could be mapped to a TSCA COU.

[a]Manufacturing of Formaldehyde for TRI and NEI were manually modified based on the COU-Occupational Exposure Scenario (OES) mapping approach covered in the Formaldehyde Occupational Exposure Assessment Module. As part of developing a number of workers estimate, TRI and NEI data is used to assign sites to the OES whose activities best fit the exposure scenario assessed for potential workers. Sites assigned to this exposure scenario are expected to manufacture formaldehyde for the sale or processing/use of formaldehyde on site. It does not include sites that noted formaldehyde was only produced as a byproduct.

Appendix F USE OF EPA RELEASE REPORTING PROGRAMS

This appendix describes EPA's methodology for downloading and processing release information from EPA release reporting programs (*i.e.*, TRI, NEI, and DMR). EPA release reporting program data was used to address all of the industrial COUs and some of the commercial COUs.

F.1 Toxics Release Inventory

Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) established the TRI. TRI tracks the waste management of designated toxic chemicals from facilities within certain industrial sectors. Facilities are required to report to TRI if the facility has 10 or more full-time employees; is included in an applicable NAICS code; and manufactures, processes, or uses the chemical in quantities greater than a certain threshold (25,000 lb for manufacturers and processors of PCE and 10,000 pounds for users of formaldehyde). EPA makes the reported information publicly available through TRI. Each facility subject to the rule must report either using a Form R or a Form A. Facilities reporting using a Form R must report annually the volume of chemical released to the environment (*i.e.*, surface water, air, or land) and/or managed through recycling, energy recovery, and treatment (*e.g.*, incineration) from the facility. Facilities may submit a Form A if the volume of chemical manufactured, processed, or otherwise used does not exceed 1,000,000 pounds per year (lb/year) and the total annual reportable releases do not exceed 500 lb/year. Facilities reporting using a Form A are not required to submit annual release and waste management volumes or use/sub-use information for the chemical.

The TRI database includes information on disposal and other releases of formaldehyde to air, water, and land, in addition to how it is being managed through recycling, treatment, and burning for energy recovery. Due to reporting limitations, some sites that manufacture, process, or use formaldehyde may not report to TRI and are therefore not included in EPA's assessment. EPA extracted both TRI Form R and Form A submissions from the TRI data plus files. EPA only assessed release distribution from Form Rs using the reported annual release volumes for total fugitive and stack emissions.

For any release quantity that is less than 1,000 lb, facilities may report either the estimated quantity or a range code. The 1,000-pound limit for range code reporting applies to each type of release reported to TRI - fugitive air emissions, stack air emissions, water discharges, each type of land disposal, and each type of off-site transfer. There are three TRI range codes: 1 to 10; 11 to 499; and 500 to 999 lb. TRI data tools display the approximate midpoint of the range (*i.e.*, 5, 250, or 750 lb). EPA used the midpoint of the range for this risk evaluation.

For this risk evaluation, EPA used TRI data from reporting years 2016 to 2021 to provide a basis for estimating releases (U.S. EPA, 2021b).

F.1.1 Using TRI Data

Step 1: Collect Air Emission Data TRI

The first step in the methodology for estimating air emissions was to obtain 2016 to 2021 TRI data for the chemical from EPA's Basic Plus Data Files. These data files were downloaded in October 11– 13, 2022. TRI requires U.S. facilities in various industrial sectors to report the annual release volumes to the environment through air emissions, water discharges, and land disposal, and/or managed through recycling, energy recovery, and treatment, including by off-site transfers. TRI reporters may report either with a Form R or a Form A. Facilities must report with a Form R, which requires reporting of release quantities and uses/sub-uses of the chemical, among other information, unless they meet the alternate threshold requirements for submitting a Form A. Specifically, facilities may submit a Form A if the volume of chemical manufactured, processed, or otherwise used does not exceed 1,000,000 lb per

year (lb/year) and the total annual reportable releases do not exceed 500 lb/year. Facilities do not need to report release quantities or uses/sub-uses on Form A. EPA included both TRI reporting Form R and TRI reporting Form A submissions in the air release spreadsheets but used Form R data to inform release estimates. Air emissions in TRI are reported separately for stack air and fugitive air and always occur on-site at the facility.

Step 2: Map Air Emission Data to Industrial sector

In the next step of air release assessment, EPA mapped the chemical's 2016-2021 TRI data to CDR Industrial sector codes using the reported primary NAICS code. EPA used the crosswalk shown in Appendix B.2.

Step 3: Identify the Manufacturing Sites

EPA then identified the sites that had reported to be manufacturing formaldehyde in 2020 or 2016 CDR. These sites were matched using the FRS IDs matching as sites may have slight variations in company names between different reporting programs or may have several locations with the same or similar site name.

Step 3: Summarize Air Emissions for each Industrial sector

Once sites had been assigned to a CDR Industrial sector, EPA first excluded Form A sites, and sites that reported no air emissions from the summary statistics. Some reported sites had either only stack emissions or only fugitive emissions. EPA calculated statistics for each type of release (i.e., stack or fugitive) only considering nonzero reported values.

EPA developed the following statistics for each industrial sector:

- Minimum, nonzero, annual fugitive emission
- Minimum, nonzero, annual stack emission
- Median, nonzero, annual fugitive emission
- Median, nonzero, annual stack emission
- 95th Percentile, nonzero, annual fugitive emission
- 95th Percentile, nonzero, annual stack emission
- Maximum, nonzero, annual fugitive emission
- Maximum, nonzero, annual fugitive emission

F.2 National Emissions Inventory

The NEI was established to track emissions of Criteria Air Pollutants (CAPs) and CAP precursors and assist with National Ambient Air Quality Standard (NAAQS) compliance under the Clean Air Act (CAA). Air emissions data for the NEI are collected at the state, local, and tribal (SLT) level. SLT air agencies then submit these data to EPA through the Emissions Inventory System (EIS). In addition to CAP data, many SLT air agencies voluntarily submit data for pollutants listed as hazardous air pollutants (HAP) under Section 112 of the Clean Air Act. EPA uses the data collected from SLT air agencies, in conjunction with supplemental HAP data, to build the NEI. EPA makes an updated NEI publicly available every three years. For this risk evaluation, EPA used NEI data from the 2017 reporting year to provide a basis for estimating releases (U.S. EPA, 2019b).

NEI emissions data is categorized into (1) point source data, (2) area or nonpoint source data, (3) onroad mobile source data, and (4) nonroad mobile source data. EPA included all four data categories in the assessment of environmental releases in this risk evaluation. Point sources are stationary sources of air emissions from facilities with operating permits under Title V of the CAA, also called "major sources."

Major sources are defined as having actual or potential emissions at or above the major source thresholds. While thresholds can vary for certain chemicals in NAAQS non-attainment areas, the default threshold is 100 tons/yr for non-HAPs, 10 tons/yr for a single HAP, or 25 tons/yr for any combination of HAPs. Point source facilities include large energy and industrial sites and are reported at the emission unit- and release point-level.

Area or nonpoint sources are stationary sources that do not qualify as major sources. The nonpoint data are aggregated and reported at the county-level and include emissions from smaller facilities as well as agricultural emissions, construction dust, and open burning. Industrial and commercial/institutional fuel combustion, gasoline distribution, oil and gas production and extraction, publicly owned treatment works, and solvent emissions may be reported in the point or nonpoint source categories depending upon source size.

Onroad mobile sources include emissions from onroad vehicles that combust liquid fuels during operation, including passenger cars, motorcycles, trucks, and buses. The nonroad mobile sources data include emissions from other mobile sources that are not typically operated on public roadways, such as locomotives, aircraft, commercial marine vessels, recreational equipment, and landscaping equipment. Onroad and nonroad mobile data is reported in the same format as nonpoint data; however, it is not available for every chemical.

For point/major sources, NEI reports emissions data at the emission unit-level. Emission units are the individual processes at a facility that have the potential to emit a regulated air pollutant. As a result, a single industrial facility, such as a refinery, may have several different emission units (e.g., process units, industrial boilers) and corresponding NEI records. The NEI also contains information on the release point where emissions from one or more emission units are released to the atmosphere. Each emission unit and release point combination comprise a unique NEI record.

F.2.1 Using NEI Data

Step 1: Collect Air Emission Data TRI

The first step in using NEI data to estimate air releases is to obtain the NEI data in a workable format that provides the requisite data for release estimation and modeling. The NEI data are available on EPA's public website as downloadable zip files, divided into onroad, nonroad, nonpoint, and point source data files.

Following download, the point and nonpoint emissions data for the chemical of interest was imported into Microsoft (MS) Excel, to be filtered and manipulated. At this point, EPA used the EIS lookup tables to populate field descriptions for data fields reported as numerical codes (*e.g.*, NAICS code).

Step 2: Map Air Emission Data to Industrial sector

In the next step of air release assessment, EPA mapped the chemical's 2017 NEI data to CDR Industrial sector codes using the reported primary NAICS code. EPA used the crosswalk shown in Appendix B.2.

Step 3: Identify the Manufacturing Sites

EPA then identified the sites that had reported to be manufacturing formaldehyde in 2020 or 2016 CDR. These sites were matched using the FRS IDs matching as well as location matching as sites may have slight variations in company names between different reporting programs or may have several locations with the same or similar site name.

Step 3: Summarize Air Emissions for each Industrial Sector

Once sites had been assigned to a CDR Industrial sector, EPA developed summary statistics for each industrial sector. Some reported sites had either only stack emissions or only fugitive emissions. EPA calculated statistics for each type of release (i.e., stack or fugitive) only considering nonzero reported values.

EPA developed the following statistics for each industrial sector:

- Minimum, nonzero, annual fugitive emission
- Minimum, nonzero, annual stack emission
- Median, nonzero, annual fugitive emission
- Median, nonzero, annual stack emission
- 95th Percentile, nonzero, annual fugitive emission
- 95th Percentile, nonzero, annual stack emission
- Maximum, nonzero, annual fugitive emission
- Maximum, nonzero, annual fugitive emission

F.3 Discharge Monitoring Report

Under the Clean Water Act (CWA), EPA regulates the discharge of pollutants into receiving waters through National Pollutant Discharge Elimination System (NPDES). A NPDES permit authorizes discharging facilities to discharge pollutants to specified effluent limits. There are two types of effluent limits: (1) technology-based and (2) water quality-based. While the technology-based effluent limits are uniform across the country, the quality-based effluent limits vary and are more stringent in certain areas. NPDES permits may also contain requirements for sewage sludge management.

NPDES permits apply pollutant discharge limits to each outfall at a facility. For risk evaluation purposes, EPA was interested only on the outfalls to surface water bodies. NPDES permits also include internal outfalls, but they are not included in this analysis. This is because these outfalls are internal monitoring points within the facility wastewater collection or treatment system, so they do not represent discharges from the facility. NPDES permits require facilities to monitor their discharges and report the results to EPA and the state regulatory agency. Facilities report these results in DMRs. EPA makes these reported data publicly available via EPA's Enforcement and Compliance History Online (ECHO) system and EPA's Water Pollutant Loading Tool (Loading Tool). The Loading Tool is a web-based tool that obtains DMR data through ECHO, presents data summaries and calculates pollutant loading (mass of pollutant discharged). For this risk evaluation, EPA queried DMRs for all formaldehyde point source water discharges available for 2016 to 2021 (U.S. EPA, 2022b).

Appendix G DETAILED COMMERCIAL COUS RELEASE ANALYSIS

This section describes the analysis of air releases for commercial COUs. Commercial COUs are not directly correlated with industrial sectors so a review of the release potential based on expected release sources, potentially applicable industrial sectors, and other alternative approaches were considered for each COU.

G.1 Distribution in Commerce

EPA expects that the main release source of formaldehyde during distribution in commerce is accidental releases of the chemical during transportation. EPA did not find any information to evaluate releases for this COU using non-programmatic data, GSs, or ESDs, nor does EPA expect this COU to be similar to other COUs such that surrogate data may be used.

Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires the person in charge of a vessel, or an onshore or offshore facility immediately notify the NRC when a CERCLA hazardous substance is released at or above the reportable quantity (RQ) in any 24-hour period unless the release is federally permitted[4]. The NRC is an emergency call center maintained and operated by the U.S. Coast Guard that fields initial reports for pollution and railroad incidents. The values within their database are from initial incident reports and are not validated. Information reported to the NRC is available on the NRC website.[5]

EPA provides NRC data for the 2016 to 2021 calendar years (NRC, 2021) for reports pertaining to spills during transportation and storage of formaldehyde for its distribution in commerce. Note that loading and unloading activities are covered in other conditions of use, and incident reports during those activities are not included in the below totals. Information on these incidents is summarized in Table_Apx G-1, noting amount is the estimate from initial reports.

Table_Apx G-1. Releases of Formaldehyde Reported to NRC

Year of Incident	Number of Incidents	Name of Material	Max Amount of Material
2016	1	RESIN (CONTAINING NITROGEN & 1% FORMALDEHYDE)	600 GALLONS
2017	6	FORMALDEHYDE SOLUTION	300 GALLONS
2018	3	FORMALDEHYDE SOLUTION	2,004 POUNDS
2018	1	FORMALIN	100 POUNDS
2018	1	STORM WATER MIXED WITH FORMALDEHYDE (1%)	3,166 GALLONS
2019	2	FORMALDEHYDE SOLUTION	4,085 POUNDS
2020	1	PARAFORMALDEHYDE	35,000 POUNDS
2021	4	FORMALDEHYDE	60 GALLONS

[4] CERCLA 103 – Release Notification; U.S. Environmental Protection Agency; https://www.epa.gov/epcra/cercla-section-103-release-notification

[5] U.S. Coast Guard National Response Center; https://nrc.uscg.mil/

G.2 Commercial Use – Chemical Substances in Furnishing Treatment/Care Products – Floor Coverings; Foam Seating and Bedding Products; Furniture and Furnishings Not Covered Elsewhere; Cleaning and Furniture Care Products; Fabric, Textile, and Leather Products Not Covered Elsewhere

EPA reviewed non-programmatic data for this COU. One source indicated that formaldehyde is released to the air during the installation and demolition of composite wood products (Matthews et al., 1986; Mølhave, 1980). Following demolition, wood products are typically disposed of to incineration or landfill (Moezzipour et al., 2018). EPA expects Construction to be a suitable surrogate for this COU, which included sites reported in 2017. These sites included 6-digit NAICS codes of, but not limited to, Commercial and Institutional Building Construction (236220) and New Housing For-Sale Builders (236117).

The range of air emissions reported under Construction are 2.5×10^{-5} to 198 kg/yr for fugitive emissions and 1 to 11,047 kg/yr for stack emissions. The highest emitter for stack emissions was Panda Sherman Power Station, which is unlikely to fit these COU, therefore a range of 1 to 1,883 kg/yr is more likely.

One reporter to the 2020 CDR reported downstream uses of formaldehyde in Furniture & furnishings including plastic articles (soft); leather articles (U.S. EPA, 2020). The reporter did not indicate a formaldehyde concentration (U.S. EPA, 2020). The reporter to the 2020 CDR for this COU claimed CBI for their PV.

G.3 Commercial Use – Chemical Substances in Treatment Products- Water Treatment Products

EPA considered release potential information within this COU using the Water Treatment Coagulants - GS for Estimating Occupational Exposures and Environmental Releases (U.S. EPA, 1994a) and the Water Treatment Disinfectants - GS for Estimating Occupational Exposures and Environmental Releases, (U.S. EPA, 1994b).

The Water Treatment Disinfectants – GS for Estimating Occupational Exposures and Environmental Releases indicated that the volatile disinfectants will be released to air during treatment or transport (U.S. EPA, 1994b). However, EPA OPPT believes the use of formaldehyde as a disinfectant would fall under FIFRA, and therefore would be a non-TSCA use. According to the Water Treatment Coagulants - GS for Estimating Occupational Exposures and Environmental Releases, nearly all of the coagulant material in water treatment will be removed as sludge waste and sent to landfill or incineration (U.S. EPA, 1994a). The function of formaldehyde in water treatment products is unclear.

Two reporters to the 2016 CDR reported downstream uses of formaldehyde in water treatment products but no reporters were identified in the 2020 CDR (U.S. EPA, 2020). 2016 CDR did not require function information to be reported with the downstream products. One of the reporters indicated a formaldehyde concentration of <1 percent and one of the reporters indicated a concentration of 1 percent - <30 percent (U.S. EPA, 2019a). Both reporters claimed CBI for their PV. With this limited information, EPA reviewed the industrial sector of Utilities and determined that this surrogate data may not fit the expected processes. The industrial sector contains Fossil Fuel Electric Power Generation, which is expected to fit with the use of fuels. EPA was not able to estimate the air emissions for this COU.

G.4 Commercial Use – Chemical Substances in Treatment/Care Products – Laundry and Dishwashing Products

EPA considered release potential information for facilities within this COU using the OECD ESD on the Chemicals Used in Water Based Washing Operations at Industrial and Institutional Laundries (OECD, 2011b).

The ESD indicates that there are six release points:

1. Transport container residue released to water, incineration, or landfill.
2. Open surface losses to air during transport container cleaning.
3. Transfer operation losses to air from unloading and transferring laundry cleaning products.
4. Dust losses during unloading and transferring solids (powdered laundry products).
5. Releases to air during washing operations.
6. Washing water discharge to POTW and evaporation losses to air during washing and drying operations.

Per the ESD, all release points have the potential for air emissions. However, the amount of formaldehyde used in laundry products is unknown. This use was not reported in CDR; therefore, no production volume information is available. Under the industrial sector of Services in 2017 NEI, there are sites with the following 6-digit NAICS codes: 812320, Drycleaning and Laundry Services (except Coin-Operated), and 812332, Industrial Launderers. The reported air emissions 0.005 to 7.4 kg/yr for fugitive emissions and 0.01 to 36 kg/yr for stack emissions. Upon close review, EPA believes these emissions are solely estimated from combustion sources and not formaldehyde use in the laundry products. Therefore, EPA was not able to estimate air releases for this COU due to lack of data on the amount of formaldehyde used and function in laundry products.

G.5 Commercial Use – Chemical substances in Construction, Paint, Electrical, and Metal Products – Adhesives and Sealants; Paint and Coatings

EPA evaluated the potential for facilities within this COU using the OECD ESD on the Coating Application via Spray-Painting in the Automotive Refinishing Industry (OECD, 2011a).

The ESD indicates that there are nine release points:

1. Transfer operation losses of volatile chemicals to air from unloading the radiation curable product.
2. Raw material sampling losses to water, incineration, or landfill (not quantified in the ESD).
3. Open surface losses of volatile chemicals to air during raw material sampling.
4. Container residue losses to water, incineration, or landfill from radiation curable product transport containers.
5. Open surface losses of volatile chemicals to air during container cleaning.
6. Process losses to air from vented or captured overspray during spray coating operations. Process losses to water,
7. land, or incineration from disposal of spent coating during roll, spray, or curtain coating.
8. Equipment cleaning losses to incineration or landfill.
9. Open surface losses of volatile chemicals to air during equipment cleaning

Per the ESD, all release points have the potential for air emissions. Under the industrial sector of Services, NEI emissions estimates for automotive repair (811121, Automotive Body, Paint, and Interior Repair and Maintenance) were below 1 kg/yr for both fugitive and stack. The low emissions may be due to the low concentration of formaldehyde within paint and coatings used in these commercial markets.

In addition to commercial uses of paints and coating for automotive refinishing, another scenario of commercial use in painting for residential and commercial buildings was considered. Under the large industry group of construction includes 238320 Painting and Wall Covering Contractors, which report higher emissions than 811121, Automotive Body, Paint, and Interior Repair and Maintenance. EPA grouped this COU with the industrial sector of Construction.

G.6 Commercial Use- Chemical Substances in Furnishing Treatment/Care Products – Building/Construction Materials – Wood and Engineered Wood Products; Building/ Construction Materials Not Covered Elsewhere

EPA reviewed non-programmatic data for this COU. One source indicated that formaldehyde is released to the air during the installation and demolition of composite wood products (Matthews et al., 1986; Mølhave, 1980). Following demolition, wood products are typically disposed of to incineration or landfill (Moezzipour et al., 2018). EPA expects Construction to be a suitable surrogate for this COU, which included sites reported in 2017 NEI. These sites included 6-digit NAICS codes of, but not limited to, Commercial and Institutional Building Construction (236220) and New Housing For-Sale Builders (236117).

The off-gassing of these products are another source of formaldehyde emissions, which will be covered in the Formaldehyde Indoor Air Assessment.

Twelve reporters to the 2020 CDR reported downstream uses of formaldehyde in construction and building materials covering large surfaces, and one reporter reported the use of formaldehyde in insulation (U.S. EPA, 2020). Six of the reporters indicated a formaldehyde concentration of <1 percent and one of the reporters indicated a concentration of 30 to <60 percent (U.S. EPA, 2020). Nine of the 12 reporters to the 2020 CDR for this OES claimed CBI for their PV. The PV of formaldehyde for the three reporters that did not claim CBI is 580,857,075 lb.

G.7 Commercial Use – Chemical Substances in Electrical Products – Electrical and Electronic Products

EPA considered the potential for air emissions for facilities within this COU using the OECD ESD for Chemicals Used in the Electronics Industry (OECD, 2010). According to the ESD, formaldehyde is used in electroless copper plating for printed circuit board manufacturing. Based on feedback during the Scope, EPA expects this use to be covered under the COU of processing aid. Based on the use report, formaldehyde is expected to be also used in molding compounds for appliances, electric controls, telephones, electrical switches and circuit breakers. As use information is limited, EPA group this COU to Electrical Equipment, Appliance, and Component Manufacturing.

G.8 Commercial Use – Chemical substances in Metal Products – Metal Products Not Covered Elsewhere

EPA identified the ESD on the Use of Metalworking Fluids (MWFs) (OECD, 2011c). However, formaldehyde is not used directly in MWFs, and the chemical that releases the formaldehyde is used as biocide in MWF, which is a non-TSCA use.

According to the use report, Formaldehyde and formaldehyde resins are used in the manufacture of metals and fabricated metal products, including metal finishings and foundry mold binders. Formaldehyde is also used in the surface coating of metal products. EPA grouped Fabricated Metal Product Manufacturing to be a suitable surrogate for this COU.

G.9 Commercial Use – Chemical Substances in Automotive Care Products; Lubricant and Greases; Fuels and Related Products

In 2020 CDR, four reporters indicated use of formaldehyde in exterior car waxes, polishes, and coatings as a binder, with only one reporter providing a maximum concentration of >1 to 30 percent. Fuel and related products were reported in 2016 CDR at less than 1 percent by weight. Lubricant and greases were identified from industry outreach and public comments (EPA-HQ-OPPT-2018- 0438-0006, EPA-HQ-OPPT-2018-0438-0024). The concentration of formaldehyde expected in industrial lubricants is greater than 0.2 percent (NICNAS, 2006).

EPA evaluated the potential for releases within this COU using the draft Commercial Use of Automotive Detailing Products - Generic Scenario for Estimating Occupational Exposures and Environmental Releases (U.S. EPA, 2022a), OECD ESD on Lubricants and Lubricant Additives (OECD, 2020), and draft Use of Fuels GS.

The draft Commercial Use of Automotive Detailing Products - Generic Scenario for Estimating Occupational Exposures and Environmental Releases (U.S. EPA, 2022a) indicates the following release points:

1. Release to fugitive air from transferring volatile chemicals from transport containers.
2. Release to fugitive air, water (POTW), or landfill from transferring solid powders.
3. Release to water (POTW) or landfill from cleaning or disposal of transport containers.
4. Release to fugitive air from cleaning containers used for volatile chemicals.
5. Release to fugitive air, water (POTW), or landfill from release of the automotive detailing product during application/detailing.

Per GS, free formaldehyde contained in the car waxes, polishes, and coatings may be released during #1,4, and 5. A worst-case calculation using the industry information in the generic scenario and formaldehyde specific information was completed. Using the 95th percentile for amount of product used per car (13.8 ounces/car) and average amount of cars per automotive detailing shop (2,191 cars), an estimated annual use rate of automotive car product would be 907 kg/yr. Assuming that range of 1 to 30 percent concentration of formaldehyde in the product gives a range of 91 to 272 kg/yr from an automotive detailing site. This calculation assumes that the formaldehyde contained in the automotive car product is fully released to air.

EPA expects the industrial sector, Services, to include the applicable NAICS codes of 811111 (General Automotive Repair), 811121 (Automotive Body, Paint, and Interior Repair and Maintenance), 811191 (Automotive Oil Change and Lubrication Shops), 811192 (Car Washes), and 811198 (All Other Automotive Repair and Maintenance). However, Services covers a wide range of NAICS code and may not be suitable as a surrogate for this COU. Reviewing only the three NAICS codes, the fugitive emissions were all less than 1 kg/yr, and a maximum of 17 kg/yr for stack emissions. These NAICS code were used as the surrogate.

EPA reviewed the OECD ESD on Chemical Additives used in Automotive Lubricants (OECD, 2020). The ESD was rated “high” during EPA’s systematic review process.

The ESD indicates that there are four release points:

1. Transfer operation losses to air during unloading.
2. Container residue and spillage losses to water (8%), incineration or landfill (92%).
3. Open surface losses to air during container cleaning.

4. Disposal of spent lubricant to incineration.

Per the ESD, all release points have the potential for air emissions. The amount of formaldehyde used in automotive lubricants is unknown; however, the ESD indicates that default concentration values for lubricant additives range from 0 to 20 percent (OECD, 2020). While formaldehyde is likely to be released from incineration, that amount may be due to other chemicals contained within the lubricant. Considering spent lubricant, the use of automotive lubricant is a 100 percent release scenario. The annual use amount for automotive lubricant is 19 million kg per site per year. Majority of that is incinerated. Reviewing surrogate NEI data, the industries associated with use of automotive lubricants include 811111 (General Automotive Repair), 811113 (Automotive Transmission Repair), 811191 (Automotive Oil Change and Lubrication Shops). These industries fall within Services, however, that industrial sector covers a wide range of NAICS codes and was not selected as a surrogate. Reviewing only the three NAICS codes, the fugitive emissions were all less than 1 kg/yr, and a maximum of 20 kg/yr for stack emissions.

EPA reviewed the draft GS Use of Chemicals in Fuel and Related Products (U.S. EPA, 2021c). The GS was rated high during EPA's systematic review process.

The GS indicates that there are six release points:

1. Releases to air from unloading fuel from transport containers into storage tanks.
2. Releases to water, landfill, or incineration from cleaning of transport containers.
3. Open surface losses to air during transport container cleaning.
4. Releases to water, landfill, or incineration from equipment cleaning.
5. Open surface losses to air during equipment cleaning.
6. Releases to incineration and air from combustion processes.

Per the draft GS, all release points have the potential for air emissions. While formaldehyde is likely to be released from incineration, that amount may be due to other chemicals contained within the fuel. The applicable NAICS code with this use includes Fossil Fuel Electric Power Generation (221112), which falls under the utilities industrial sector. The emissions identified for this industrial sector will be highly influenced by formaldehyde generated from combustion processes and will characterize industrial levels use of fuel.

For refueling stations, the GS identified that the National Association of Convenience Stores found that the fuel industry used 74 barrels of gasoline per site per day (8,820 L) in 2015. The concentration of formaldehyde reported the lowest code in 2016 CDR which was less than 1 percent and the draft GS indicated a maximum additive amount of 0.05 percent based on a review of common fuel additives. This indicates approximately 1,207 kg of formaldehyde is used in fuel at refueling stations. Therefore, the use of the industrial sector of utilities may best represent the use of fuel at large industrial sites but the use of fuel at smaller refueling stations will be significantly lower.

G.10 Commercial Use – Chemical Substances in Agriculture Use Products – Lawn and Garden Products

Following the application of fertilizer to land, any spent or additional fertilizer applied may drain into the surface or groundwater; therefore, EPA expects most of the releases to either go to land or water. One reporter to the 2020 CDR reported a maximum concentration of <1 percent formaldehyde for the commercial use of agricultural non-pesticidal products, and another reporter indicated a maximum concentration of 30 to less than60 percent formaldehyde (U.S. EPA, 2020). The high concentration reported may refer to the intermediate product sold as urea formaldehyde concentrate (UFC), which

contains 60 percent formaldehyde. This product is then used in the production of solid urea and ureaform fertilizers (U.S. EPA, 1991). Residual formaldehyde content in the product applied is expected to match the reported less than 1 percent of free formaldehyde. EPA grouped this COU with the NEI Industrial sector of Agriculture, Forestry, Fishing and Hunting. Due to CBI claims in CDR, the total volume of formaldehyde is unknown; however, one site reported a PV of 3,093,240 lb (U.S. EPA, 2020).

G.11 Commercial Use – Chemical Substances in Outdoor Use Products-Explosive Materials

EPA has limited information on this COU, explosives could be used during demolition projects or by the military. In addition, EPA identified emission data from pyrotechnics, with a range of emission of formaldehye of <7.0 mg/kg combusted device to 82 mg/kg combusted device. While EPA did not identify general use information for pyrotechnics, it can be expected that commercial use of pyrotechnics are not a continuous activity at the same site. Formaldehyde releases to air are expected following the detonation of the explosive material (Croteau et al., 2010). EPA expects all formaldehyde used to go to air. No 2020 submitter reported explosive materials, but one site indicated that formaldehyde is used as a chemical reactant for propellant. In 2016, one manufacturer reported explosive materials at a concentration of less than 1 percent (U.S. EPA, 2020).

G.12 Commercial Use – Chemical Substances in Packaging, Paper, Plastic, Hobby Products – Paper Products; Plastic and Rubber Products; Toys, Playground, and Sporting Equipment

Per the GS, paper will eventually be landfilled or repulped, resulting in land releases (U.S. EPA, 2000). EPA expects the fate of packaging and hobby products to be similar to paper. EPA expect use of these products may occur at printing sites; therefore, EPA grouped this COU with the NEI Industrial sector of Printing and Related Support Activities. A reporter to the 2020 CDR indicated a maximum formaldehyde concentration of 1 percent to <30 percent with a PV of 46,119 lb. (U.S. EPA, 2020).

G.13 Commercial Use – Chemical Substances in Packaging, Paper, Plastic, Hobby Products – Arts, Crafts, and Hobby Materials

EPA evaluated the potential for releases within this COU using non-programmatic data. One source identified formaldehyde released to air during the use of a 3D printer (Davis et al., 2019). The source did not indicate land releases; however, EPA expects spent craft materials to be disposed of in a landfill. EPA did not identify releases related to the use of other types of craft materials. EPA expect use of these products may occur at printing sites; therefore, EPA grouped this COU with the NEI Industrial sector of Printing and Related Support Activities.

G.14 Commercial Use – Chemical substances in Packaging, Paper, Plastic, Hobby Products – Ink, Toner, and Colorant Products; Photographic Supplies

The Manufacture and Use of Printing Ink – GS for Estimating Occupational Exposures and Environmental Releases indicates that there are six release points:

1. Release to incineration or land from container residue.
2. Release to air during unloading from volatile components.
3. Release to air in the ink reservoir.
4. Release to air from ink mist generated by a printing press.
5. Release to incineration or land from equipment cleaning residuals.

6. Release to air during drying (U.S. EPA, 2010).

The Flexographic Printing Ink – GS for Estimating Occupational Exposures and Environmental Releases indicates that there are three release points:

1. Release of hazardous liquid waste to incineration or landfill from equipment cleaning.
2. Fugitive release to air.
3. Stack release to air (U.S. EPA, 1999).

Per the GSs, air emissions are expected for all release points. One source indicated a formaldehyde concentration of 0.1 percent in inks (Kim et al., 2011). No information is available regarding the PV of formaldehyde used for printing ink, toner, and colorant products. EPA grouped this COU with the NEI Industrial sector of Printing and Related Support Activities.

EPA evaluated the potential for releases within this COU using the Photographic Industry - GS for Estimating Occupational Exposures and Environmental Releases (U.S. EPA, 2004).

The GS indicates two release points:

1. Release to water from rinsing after film development.
2. Release to water from special disposal companies for photochemicals.

Based on the GS, air release points are not provided for photo processing using formulations containing formaldehyde. (U.S. EPA, 2004). According to the NICNAS, formaldehyde is used in a variety of different film development processes in concentrations ranging anywhere from 1 to 35 percent (NICNAS, 2006). The EPA did not identify any PV for this OES, as it was not reported in the 2016 or 2020 CDR. EPA grouped this COU with the NEI Photographic Film Paper, Plate, and Chemical Manufacturing

G.15 Commercial Use – Chemical substances in Products Not Described by Other Codes – Other: Laboratory Chemicals

EPA considered releases for facilities within this COU using the Draft Use of Laboratory Chemicals - GS for Estimating Occupational Exposures and Environmental Releases (U.S. EPA, 2023).

The GS indicates that there are eight release points:

1. Releases to air from transferring volatile chemicals from unloading volatile chemicals
2. Releases to air, water, incineration, or landfill from unloading solid chemicals
3. Releases to water, incineration, or landfill from container residue losses
4. Releases to air from cleaning containers used for volatile chemicals
5. Releases to water, incineration, or landfill from equipment cleaning
6. Releases to air from labware equipment cleaning for volatile chemicals
7. Releases to air from laboratory analyses of volatile chemicals
8. Release to water, incineration, or landfill from disposal of laboratory waste

Based on the GS, all release points have the potential for air emissions; however, release point #2 is not expected as formaldehyde is commonly in a liquid solution (NICNAS, 2006). The EPA/OPPT Small Container Residual Model and EPA/OPPT Solid Residuals in Transport Containers Model in the GS estimates that 0.6 weight percent of contents in small containers, and 1 weight percent of solids contents may be released to the environment for release point #3 (U.S. EPA, 2023). The model also estimates that release points #3, 5, and 8 will exclusively be released to incineration or to land since formaldehyde is a hazardous chemical (U.S. EPA, 2023). The concentration of formaldehyde in general laboratory use can range from 1 to 40 percent (U.S. EPA, 2020; Bruno et al., 2018). According to the 2020 CDR, 324,000

lb of formaldehyde was used for laboratory use (U.S. EPA, 2020). Formalin use as a preservative for biological specimen often occur in laboratories but the use is not included as this use is excluded from TSCA. Formalin may be used as an analytical standard, tissue fixative, or in gel electrophoresis. Using the GS, the use rate of general laboratory stock solutions is 4,000 mL as a high-end estimate for liquid products. EPA expects the most common lab grade of 37 percent formaldehyde will be used. At that concentration and use rate, an expected 314 kg/yr for general lab use was calculated. Considering that the hazardous waste will likely be sent off-site for incineration, EPA expects air emissions exclusive to TSCA uses for lab use (e.g., analytical standards) to be low for this COU.

For a review of available NEI data, the following NAICS codes were expected to be associated with laboratories: 541380 (Testing Laboratories), 621511 (Medical Laboratories), and 339116 (Dental Laboratories). The maximum air emissions reported is 78 for fugitive emissions and 305 kg/yr for stack emissions. There is uncertainty with this NEI data as formaldehyde has some non-TSCA uses which could occur in labs.