

Economic Analysis of the Final Regulation of Methylene Chloride Under TSCA Section 6(a)

**May 2024**

**Office of Pollution Prevention and Toxics**

**U.S. Environmental Protection Agency**

Economic Analysis of the Final Regulation of Methylene Chloride Under TSCA Section 6(a)

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**Office of Pollution Prevention and Toxics**

**U.S. Environmental Protection Agency**

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Notice

This document was prepared to provide economic information for the rulemaking process and to meet various administrative and legislative requirements. Due to the nature of the information available to EPA, the document contains various assumptions that may not reflect how all regulated entities would comply with the rule's requirements. Persons seeking information on regulatory requirements as they apply to specific facilities should consult 40 CFR part 751, the preamble for the regulatory action, and EPA guidance documents.

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| List of Key Abbreviations and Acronyms | |
| AC | Air Conditioner |
| ACS | American Community Survey |
| AIM | Innovation and Manufacturing Act |
| AL | Action Level |
| APF | Assigned Protection Factors |
| BLS | U.S. Bureau of Labor Statistics |
| BMD | Benchmark Dose |
| BMDL | Benchmark Dose Limit |
| CAA | Clean Air Act |
| CARB | California Air Resources Board |
| CDC | Center for Disease Control and Prevention |
| CDR | Chemical Data Reporting |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CIH | Certified Industrial Hygienist |
| CNS | Central Nervous System |
| COU | Conditions of Use |
| CPID | Consumer Product Information Database |
| CPSC | U.S. Consumer Product Safety Commission |
| CWA | Clean Water Act |
| DDCC | Direct Dermal Contact Controls |
| ECEC | Employer Costs for Employee Compensation |
| ECEL | Existing Chemical Exposure Limit |
| ECHO | EPA Enforcement and Compliance History Online |
| EJ | Environmental Justice |
| EPA | U.S. Environmental Protection Agency |
| FDA | Food and Drug Administration |
| FFDCA | Federal Food, Drug, and Cosmetic Act |
| FHSA | Federal Hazardous Substances Act |
| GDP | Gross Domestic Product |
| HAP | Hazardous Air Pollutant |
| HFC | Hydrofluorocarbons |
| HOC | Hierarchy of Controls |
| HSIA | Halogenated Solvents Industry Alliance |
| HSP | Hansen Solubility Parameters |
| ICR | Information Collection Request |
| IUR | Inhalation Unit Risk |
| LADC | Lifetime Average Daily Concentration |
| MCL | Maximum Contaminant Level |
| MCLG | Maximum Contaminant Level Goal |
| NAFLD | Non-Alcoholic Fatty Liver Disease |
| NAICS | North American Industry Classification System |
| NATA | National Air Toxics Assessment |
| NEI | National Emissions Inventory |
| NESHAP | National Emission Standards for Hazardous Air Pollutants |
| NIOSH | National Institute for Occupational Safety and Health |
| NPDWR | National Primary Drinking Water Regulation |
| ODC | Other Direct Costs |
| OEL | Occupational Exposure Limit |
| OES | Occupational Exposure Scenarios |
| ONU | Occupational Non-Users |
| OSHA | Occupational Safety and Health Administration |
| OTC | Ozone Transport Commission |
| PBPK | Physiologically Based Pharmacokinetic |
| PEL | Permissible Exposure Limit |
| PPE | Personal Protective Equipment |
| PVA | Polyvinyl alcohol |
| PVC | Polyvinyl chloride |
| QALY | Quality Adjusted Life-Years |
| RCRA | Resource Conservation and Recovery Act |
| REACH | Registration, Evaluation, Authorization and Restriction of Chemicals |
| RFA | Regulatory Flexibility Act |
| SAR | Supplied Air Respirators |
| SBA | U.S. Small Business Administration |
| SBAR | Small Business Advocacy Review |
| SBREFA | Small Business Regulatory Enforcement Fairness Act |
| SCAQMD | South Coast Air Quality Management District |
| SDS | Safety Data Sheet |
| SDWA | Safe Drinking Water Act |
| SNAP | Significant New Alternatives Policy |
| STEL | Short Term Exposure Limit |
| SUSB | Statistics of U.S. Businesses |
| TRI | Toxics Release Inventory |
| TSCA | Toxic Substances Control Act |
| TTO | Total Toxic Organics |
| TURI | Toxics Use Reduction Institute |
| TWA | Time Weighted Average |
| VOC | Volatile Organic Compound |
| VSL | Value of a Statistical Life |
| WCPP | Workplace Chemical Protection Program |

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Executive Summary

Introduction

The U.S. Environmental Protection Agency (EPA) is finalizing a rule under section 6(a) of the Toxic Substances Control Act (TSCA) for methylene chloride to address the unreasonable risk of injury to human health under its conditions of use (COUs). This report estimates and evaluates the costs, benefits, and impacts expected to result from the rule to regulate manufacture (including import), processing, distribution in commerce, industrial and commercial use, and disposal of methylene chloride to address unreasonable risks so that they are no longer unreasonable. EPA is finalizing the regulation under the authority of TSCA section 6(a) after completing a risk evaluation under TSCA section 6(b) and determining that the chemical substance presents an unreasonable risk of injury to human health. The rule, “Regulation of Methylene Chloride Under TSCA Section 6(a),” addresses the unreasonable risk EPA determined is presented by methylene chloride under the COUs. These COUs are presented below in Table ES-1. Table ES-1 also lists the use categories and defines how the economic analysis use categories map to the COUs. The use categories are the categories of methylene chloride use that are considered in the economic analysis.[[1]](#footnote-3)

| Table ES-1: Use Categories Considered in the Economic Analysis Mapped to the Conditions of Use (COUs) Defined in the Risk Evaluation | |
| --- | --- |
| Use Category | Condition of Use (COU) |
| Manufacturing | Manufacturing (Domestic manufacturing) |
| Import/Repackage | Manufacturing (Import) |
| Processing: repackaging |
| Processing as a Reactant | Processing: processing as a reactant |
| Incorporation Into Formulation, Mixture, or Reaction Product | Processing: incorporation into a formulation, mixture, or reaction product |
| Industrial and commercial use as solvent that becomes part of a formulation or mixture |
| Waste Handling, Disposal, Treatment, and Recycling | Processing: recycling |
| Disposal |
| Laboratory Use | Industrial and commercial use as a laboratory chemical |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Industrial and commercial use as a processing aid |
| Industrial and commercial use as a solvent that becomes part of a formulation or mixture, where that formulation or mixture will be used inside a manufacturing process, and the solvent (methylene chloride) will be reclaimed |
| Industrial and commercial use for plastic and rubber products manufacturing |
| Industrial or commercial use as a bonding agent for solvent welding |
| Aerospace Paint and Coating Removers | Industrial and commercial use as a paint and coating remover from safety critical, corrosion-sensitive components of aircraft and spacecraft |
| Cellulose Triacetate Film Production | Industrial and commercial use in cellulose triacetate film production |
| Furniture Refinishing | Industrial and commercial use in paint and coating removal in furniture refinishing for intricate or historically significant wood pieces |
| Glues, Sealants, Adhesives, and Caulks | Industrial and commercial use in adhesives and sealants in aircraft, space vehicle, and turbine applications for structural and safety critical non-structural applications |
| Industrial and commercial use in adhesives, sealants and caulks (except adhesives and sealants in aircraft, space vehicle, and turbine applications for structural and safety critical non-structural applications) |
| Consumer use in adhesives and sealants |
| Consumer use in arts, crafts, and hobby materials glue |
| Vapor Degreasing | Industrial and commercial use as solvent for batch vapor degreasing |
| Industrial and commercial use as solvent for in-line vapor degreasing |
| Liquid Cleaners and Degreasers | Industrial and commercial use as solvent for cold cleaning |
| Industrial and commercial use in metal non-aerosol degreasers |
| Industrial and commercial use in non-aerosol degreasers and cleaners |
| Aerosol Spray Cleaning/Degreasing | Industrial and commercial use as a solvent for aerosol spray degreaser/cleaner |
| Industrial and commercial use in metal aerosol degreasers |
| Industrial and commercial use in automotive care products (interior car care) |
| Industrial and commercial use in automotive care products (degreasers) |
| Industrial and commercial use in aerosol degreasers and cleaners |
| Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner1 |
| Consumer use as solvent in aerosol degreasers/cleaners |
| Consumer use in metal degreasers |
| Consumer use in automotive care products (degreasers) |
| Consumer use in carbon removers and other brush cleaners1 |
| Paint and Coating Removers (except aerospace and furniture refinishing) | Industrial and commercial use in paint and coating removers (except select wood furniture and safety critical, corrosion-sensitive components of aircraft and spacecraft) |
| Adhesive and Caulk Remover | Industrial and commercial use in adhesive and caulk removers |
| Consumer use in adhesive and caulk removers |
| Lithographic Printing Cleaner | Industrial and commercial use in lithographic printing plate cleaner |
| Dry Cleaning and Spot Removers | Industrial and commercial use in spot removers for apparel and textiles |
| Paint and Coatings | Industrial and commercial use in paints and coatings |
| Lubricants and Greases | Industrial and commercial use in liquid lubricants and greases |
| Industrial and commercial use in spray lubricants and greases |
| Consumer use in lubricants and greases |
| Cold Pipe Insulation | Industrial and commercial use in cold pipe insulations |
| Consumer use in cold pipe insulation |
| Anti-spatter Welding Aerosol | Industrial and commercial use as anti-spatter welding aerosol |
| Consumer use in an anti-spatter welding aerosol |
| Uses believed to be inactive or fully overlap with other conditions of use | |
| Toys, Playground, and Supporting Equipment | Industrial and commercial use in toys, playground and sporting equipment |
| Wood Floor and Brush Cleaners | Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner1 |
| Consumer use in carbon removers and other brush cleaners1 |
| Consumer use in brush cleaners for paints and coatings2 |
| Functional Fluids | Industrial and commercial use in automotive care products (functional fluids for air conditioners2 |
| Consumer use in automotive care products (functional fluids for air conditioners)2 |
| Propellant and Blowing Agent | Industrial and commercial use as a propellant and blowing agent3 |
| Finishing Products for Fabric, Textiles and Leather | Industrial and commercial use in finishing products for fabric, textiles and leather4 |
| Industrial and commercial use in apparel and footwear care products4 |
| Electrical Equipment, Appliance, and Component Manufacturing | Industrial and commercial use for electrical equipment, appliance, and component manufacturing4 |
| Oil and Gas Drilling | Industrial and commercial use for oil and gas drilling, extraction, and support activities4 |

Background

Methylene chloride (CASRN 75-09-2), also known as dichloromethane, is a colorless liquid with a penetrating, ether-like odor. It is produced by the direct reaction of methane with chlorine at either high temperatures or low temperatures under catalytic or photolytic conditions. The principal uses for methylene chloride have been in paint strippers and removers, as a propellant in aerosols, in the manufacture of pharmaceuticals, film coatings, electronics, and polyurethane foam, and as a metal-cleaning solvent ([EPA 2011b](#_ENREF_84)).

EPA’s *Risk Evaluation for Methylene Chloride* identified six non-cancer adverse health effects: effects from acute/short-term exposure, liver effects, immune system effects, nervous system effects, reproductive/developmental effects and irritation/burns ([EPA 2020i](#_ENREF_104)). The Risk Evaluation also identified cancer hazards from carcinogenicity as well as genotoxicity, particularly for liver and lung tumors ([EPA 2020i](#_ENREF_104)).

Among the non-cancer adverse health effects, the Risk Evaluation identified neurotoxicity indicative of central nervous system depression as a primary effect of methylene chloride in humans following acute inhalation exposures ([EPA 2020i](#_ENREF_104)). Identified central nervous system depressive symptoms include drowsiness, confusion, headache, dizziness, and neurobehavioral deficits when performing various tasks. Central nervous system depressant effects can result in loss of consciousness and respiratory depression, resulting in irreversible coma, hypoxia and eventual death ([EPA 2020i](#_ENREF_104)).

Additionally, the *Risk Evaluation for Methylene Chloride* identified the liver as a sensitive target organ for inhalation exposure ([EPA 2020i](#_ENREF_104)). For human health risks to workers and consumers, EPA identified potential cancer and non-cancer human health risks. Risks from acute exposures include central nervous system risks such as central nervous system depression and a decrease in peripheral vision, each of which can lead to workplace accidents and which are precursors to more severe central nervous system effects such as incapacitation, loss of consciousness, and death. For chronic exposures, EPA identified risks of non-cancer liver effects as well as liver and lung tumors. ([EPA 2020i](#_ENREF_104)).

The Risk Evaluation also identified several irritation hazards from methylene chloride exposure. Following exposures to methylene chloride vapors, irritation has been observed in the respiratory tract and eyes. Direct contact with liquid methylene chloride on the skin has caused chemical burns in workers and gastrointestinal irritation in individuals who accidentally ingested methylene chloride ([EPA 2020i](#_ENREF_104)).

Options Analyzed

To address the unreasonable risk EPA identified in the *Risk Evaluation for Methylene Chloride*, EPA’s final rule will: prohibit the manufacture, processing, and distribution in commerce of methylene chloride for consumer use; prohibit most industrial and commercial uses of methylene chloride; require a workplace chemical protection program (WCPP), which would include a requirement to meet inhalation exposure concentration limits, for certain continued conditions of use of methylene chloride; require recordkeeping and downstream notification requirements for several conditions of use of methylene chloride; and provide time-limited exemptions as appropriate under TSCA section 6(g).

EPA considered an alternative regulatory option, Option 2, to address the unreasonable risk EPA has identified. This option would prohibit the manufacture, processing, and distribution in commerce of methylene chloride for consumer use; prohibit most industrial and commercial uses of methylene chloride (but would allow a WCPP for Cellulose Triacetate Film Production and prohibit methylene chloride use for the processing aid, plastics manufacturing, and solvent welding use category and the aerospace paint and coatings use category after a 10-year interim WCPP requirement). The alternative option would also require recordkeeping and downstream notification requirements for several conditions of use of methylene chloride; and provide time-limited exemptions under TSCA section 6(g).

Table ES-2 presents a summary of the options analyzed by use category.

| Table ES-2: Summary of Options Analyzed by Use Category | | | |
| --- | --- | --- | --- |
| Use Category | Condition of Use (COU) | Option 1 | Option 2 |
| Manufacturing | Manufacturing (Domestic manufacturing) | WCPP | WCPP |
| Import/Repackage | Manufacturing (Import) |
| Processing: repackaging |
| Processing as a Reactant | Processing: processing as a reactant |
| Incorporation Into Formulation, Mixture, or Reaction Product | Processing: incorporation into a formulation, mixture, or reaction product |
| Industrial and commercial use as solvent that becomes part of a formulation or mixture |
| Waste Handling, Disposal, Treatment, and Recycling | Processing: recycling |
| Disposal |
| Laboratory Use | Industrial and commercial use as a laboratory chemical |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Industrial and commercial use as a processing aid | Prohibit |
| Industrial and commercial use as a solvent that becomes part of a formulation or mixture, where that formulation or mixture will be used inside a manufacturing process, and the solvent (methylene chloride) will be reclaimed |
| Industrial and commercial use for plastic and rubber products manufacturing |
| Industrial or commercial use as a bonding agent for solvent welding |
| Aerospace Paint and Coating Removers | Industrial and commercial use as a paint and coating remover from safety critical, corrosion-sensitive components of aircraft and spacecraft | Prohibit with a 10-year time-limited exemption and interim WCPP |
| Cellulose Triacetate Film Production | Industrial and commercial use in cellulose triacetate film production | Prohibit | WCPP |
| Furniture Refinishing | Industrial and commercial use in paint and coating removal in furniture refinishing for wooden pieces of artistic, cultural, or historic value | Prohibit after 5 years with interim worker protection requirements | Prohibit |
| Glues, Sealants, Adhesives, and Caulks | Industrial and commercial use in adhesives and sealants in aircraft, space vehicle, and turbine applications for structural and safety critical non-structural applications | Prohibit after 5 years | Prohibit |
| Industrial and commercial use in adhesives, sealants and caulks (except adhesives and sealants in aircraft, space vehicle, and turbine applications for structural and safety critical non-structural applications) | Prohibit | Prohibit |
| Consumer use in adhesives and sealants |
| Consumer use in arts, crafts, and hobby materials glue |
| Vapor Degreasing | Industrial and commercial use as solvent for batch vapor degreasing |
| Industrial and commercial use as solvent for in-line vapor degreasing |
| Liquid Cleaners and Degreasers | Industrial and commercial use as solvent for cold cleaning |
| Industrial and commercial use in metal non-aerosol degreasers |
| Industrial and commercial use in non-aerosol degreasers and cleaners |
| Aerosol Spray Cleaning/Degreasing | Industrial and commercial use as a solvent for aerosol spray degreaser/cleaner |
| Industrial and commercial use in metal aerosol degreasers |
| Industrial and commercial use in automotive care products (interior car care) |
| Industrial and commercial use in automotive care products (degreasers) |
| Industrial and commercial use in aerosol degreasers and cleaners |
| Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner1 |
| Consumer use as solvent in aerosol degreasers/cleaners |
| Consumer use in metal degreasers |
| Consumer use in automotive care products (degreasers) |
| Consumer use in carbon removers and other brush cleaners1 |
| Paint and Coating Removers (except aerospace and furniture refinishing) | Industrial and commercial use in paint and coating removers (except select wood furniture and safety critical, corrosion-sensitive components of aircraft and spacecraft) |
| Adhesive and Caulk Remover | Industrial and commercial use in adhesive and caulk removers |
| Consumer use in adhesive and caulk removers |
| Lithographic Printing Cleaner | Industrial and commercial use in lithographic printing plate cleaner |
| Dry Cleaning and Spot Removers | Industrial and commercial use in spot removers for apparel and textiles |
| Paint and Coatings | Industrial and commercial use in paints and coatings |
| Lubricants and Greases | Industrial and commercial use in liquid lubricants and greases |
| Industrial and commercial use in spray lubricants and greases |
| Consumer use in lubricants and greases |
| Cold Pipe Insulation | Industrial and commercial use in cold pipe insulations |
| Consumer use in cold pipe insulation |
| Anti-spatter Welding Aerosol | Industrial and commercial use as anti-spatter welding aerosol |
| Consumer use in an anti-spatter welding aerosol |
| Toys, Playground, and Supporting Equipment | Industrial and commercial use in toys, playground and sporting equipment |
| Uses believed to be inactive or fully overlap with other conditions of use | |  |  |
| Wood Floor and Brush Cleaners | Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner1 | Prohibit | Prohibit |
| Consumer use in carbon removers and other brush cleaners1 |
| Consumer use in brush cleaners for paints and coatings2 |
| Functional Fluids | Industrial and commercial use in automotive care products (functional fluids for air conditioners2 |
| Consumer use in automotive care products (functional fluids for air conditioners)2 |
| Propellant and Blowing Agent | Industrial and commercial use as a propellant and blowing agent3 |
| Finishing Products for Fabric, Textiles and Leather | Industrial and commercial use in finishing products for fabric, textiles and leather4 |
| Industrial and commercial use in apparel and footwear care products4 |
| Electrical Equipment, Appliance, and Component Manufacturing | Industrial and commercial use for electrical equipment, appliance, and component manufacturing4 |
| Oil and Gas Drilling | Industrial and commercial use for oil and gas drilling, extraction, and support activities4 |
| 1EPA believes that brush cleaning is an inactive use. Wood floor cleaning is also believed to be an inactive use (although paint removers may be used for this purpose). Carbon removers are an active use and included under aerosol spray cleaning/degreasing. Note that these COUs are listed twice since they include both active and inactive uses.  2Based on market research, EPA believes these are inactive uses.  3Based on stakeholder outreach with industry, EPA believes this is an inactive use.  4These COUs are defined according to the sector using methylene chloride. EPA believes that there are no active uses in these sectors or that the uses by these sectors overlap with one or more of the COUs that are defined according to how the methylene chloride is being used.  Note: Use of methylene chloride by Federal agencies and contractors acting for or on behalf of Federal agencies are subject to a different compliance timeframe not captured in our analyses. | | | |

Estimated Number of Affected Entities and Individuals

Table ES-3 presents a summary of the number of firms using methylene chloride and the number of occupational and consumer users exposed to methylene chloride for each use category. Occupational users are potentially exposed persons and include workers working directly with methylene chloride as well as occupational non-users (ONUs).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table ES-3: Summary of Occupational and Consumer Users | | | | |
| Use Category | Number of Facilities | Number of Workers | Number of ONUs | Number of Consumers |
| Manufacturing | 6 | 533 | 211 | - |
| Import/Repackage | 26 | 587 | 232 | - |
| Processing as a reactant | 35 | 703 | 277 | - |
| Incorporation Into Formulation, Mixture, or Reaction Product | 54 | 310 | 122 | - |
| Waste Handling, Disposal, Treatment, and Recycling | 1,091 | 7,493 | 4,746 | - |
| Laboratory Use | 56 | 183 | 0 | - |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | 44 | 352 | 0 | - |
| Aerospace Paint and Coating Removers | 272 | 762 | 72 | 0 |
| Cellulose Triacetate Film Production | 1 | 5 | 2 | - |
| Furniture Refinishing | 4,899 | 11,625 | 1,101 | 0 |
| Vapor Degreasing | 17 | 71 | 42 | - |
| Liquid Cleaners and Degreasers | 7,190 | 14,900 | 35,760 | - |
| Aerosol Spray Cleaning/Degreasing | 170,063 | 523,102 | 58,122 | 184,310 |
| Paint and Coating Removers (except aerospace and furniture refinishing) | 8,371 | 21,749 | 2,060 | - |
| Adhesive and Caulk Remover | 3,986 | 48,523 | 4,597 | 15,137 |
| Lithographic Printing Cleaner | 221 | 2,672 | 1,269 | - |
| Dry Cleaning and Spot Removers | 1,391 | 2,792 | 527 | - |
| Paint and Coatings | 123 | 799 | 151 | - |
| Glues, Sealants, Adhesives, and Caulks | 3,986 | 40,862 | 12,259 | 13,917,131 |
| Lubricants and Greases | 19,450 | 46,967 | 5,448 | 1,086,470 |
| Cold Pipe Insulation | 10,695 | 46,521 | 5,396 | 138,855 |
| Anti-spatter Welding Aerosol | 5,992 | 14,820 | 1,719 | 5,411 |
| **Total** | **237,969** | **786,331** | **134,113** | **15,347,314** |

Estimated Incremental Costs

Table ES-4 and Table ES-5 present the total 20-year annualized costs for 3 and 7 percent discount rates, respectively. Note that for use categories for which Options 1 and 2 require prohibition and WCPP respectively, it is assumed that compliance with the WCPP is achieved by switching to alternatives if the estimated costs of switching are smaller than the costs of WCPP requirements.

Costs are presented in 2022 dollars in this document unless otherwise noted.

|  |  |  |
| --- | --- | --- |
| Table ES-4: Total 20-Year Annualized Costs by Use Category by Option (3% Discount Rate, 2022$) | | |
| Use Category | Option 1  (Final Rule) | Option 2  (Alternative Option) |
| Manufacturing | $208,710 | $208,710 |
| Import/Repackage | $851,208 | $851,208 |
| Processing as a reactant | $646,156 | $646,156 |
| Incorporation Into Formulation, Mixture, or Reaction Product | $98,086 | $98,086 |
| Waste Handling, Disposal, Treatment, and Recycling | $8,811,805 | $8,811,805 |
| Laboratory Use | $281,701 | $281,701 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | $865,821 | $166,273,554 |
| Aerospace Paint and Coating Removers | $2,169,359 | $2,169,359 |
| Cellulose Triacetate Film Production | $12,485 | $12,485 |
| Furniture Refinishing | $16,491,740 | $16,491,740 |
| Glues, Sealants, Adhesives, and Caulks | $236,910 | $318,387 |
| Vapor Degreasing | $4,223,532 | $4,223,532 |
| Liquid Cleaners and Degreasers | $55,177 | $55,177 |
| Aerosol Spray Cleaning/Degreasing | $1,057,880 | $1,057,880 |
| Paint and Coating Removers (Graffiti Removal) | $815 | $815 |
| Paint and Coating Removers (Bathtub Refinishing) | $3,384 | $3,384 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | $47,971 | $47,971 |
| Paint and Coating Removers (Art Restoration) | $309 | $309 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | $10,337 | $10,337 |
| Paint and Coating Removers (Professional Contracting) | $4,827 | $4,827 |
| Adhesive and Caulk Remover | $31,968 | $31,968 |
| Lithographic Printing Cleaner | $17,686 | $17,686 |
| Dry Cleaning and Spot Removers | $12,477 | $12,477 |
| Paint and Coatings | $504,014 | $504,014 |
| Lubricants and Greases | $140,607 | $140,607 |
| Cold Pipe Insulation | $64,473 | $64,473 |
| Anti-spatter Welding Aerosol | $97,130 | $97,130 |
| **Total** | **$36,946,566** | **$202,435,776** |
| Note that the costs of prohibition for the Aerospace Paint and Coating Removers, and Cellulose Triacetate Film Production use categories are estimated using the WCPP costs as a proxy for the costs of prohibition. For furniture refinishing, the APF 50 respirator costs are used as a proxy for prohibition costs. These proxies are considered lower bound estimates. Since switching to alternatives is an available compliance strategy under the conditions of use with WCPP requirements (or respirator requirements), it is reasonable to assume that affected entities would simply switch to an alternative if it is less costly to switch compared to the costs of compliance with a WCPP. | | |

|  |  |  |
| --- | --- | --- |
| Table ES-5: Total 20-Year Annualized Costs by Use Category by Option (7% Discount Rate, 2022$) | | |
| Use Category | Option 1  (Final Rule) | Option 2  (Alternative Option) |
| Manufacturing | $207,431 | $207,431 |
| Import/Repackage | $843,084 | $843,084 |
| Processing as a reactant | $640,793 | $640,793 |
| Incorporation Into Formulation, Mixture, or Reaction Product | $97,174 | $97,174 |
| Waste Handling, Disposal, Treatment, and Recycling | $8,753,047 | $8,753,047 |
| Laboratory Use | $279,477 | $279,477 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | $858,085 | $227,704,065 |
| Aerospace Paint and Coating Removers | $2,149,268 | $2,149,268 |
| Cellulose Triacetate Film Production | $12,368 | $12,368 |
| Furniture Refinishing | $16,663,010 | $16,663,010 |
| Glues, Sealants, Adhesives, and Caulks | $221,649 | $436,017 |
| Vapor Degreasing | $5,966,075 | $5,966,075 |
| Liquid Cleaners and Degreasers | $75,563 | $75,563 |
| Aerosol Spray Cleaning/Degreasing | $1,448,718 | $1,448,718 |
| Paint and Coating Removers (Graffiti Removal) | $1,116 | $1,116 |
| Paint and Coating Removers (Bathtub Refinishing) | $4,634 | $4,634 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | $65,694 | $65,694 |
| Paint and Coating Removers (Art Restoration) | $424 | $424 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | $14,156 | $14,156 |
| Paint and Coating Removers (Professional Contracting) | $6,611 | $6,611 |
| Adhesive and Caulk Remover | $43,778 | $43,778 |
| Lithographic Printing Cleaner | $24,220 | $24,220 |
| Dry Cleaning and Spot Removers | $17,086 | $17,086 |
| Paint and Coatings | $690,224 | $690,224 |
| Lubricants and Greases | $192,555 | $192,555 |
| Cold Pipe Insulation | $88,293 | $88,293 |
| Anti-spatter Welding Aerosol | $133,015 | $133,015 |
| **Total** | **$39,497,548** | **$266,557,895** |
| Note that the costs of prohibition for the Aerospace Paint and Coating Removers, and Cellulose Triacetate Film Production use categories are estimated using the WCPP costs as a proxy for the costs of prohibition. For furniture refinishing, the APF 50 respirator costs are used as a proxy for prohibition costs. These proxies are considered lower bound estimates. Since switching to alternatives is an available compliance strategy under the conditions of use with WCPP requirements (or respirator requirements), it is reasonable to assume that affected entities would simply switch to an alternative if it is less costly to switch compared to the costs of compliance with a WCPP. | | |

**Unquantified Costs**

This economic analysis does not include quantified cost estimates for all costs under the options assessed. Although certain costs cannot be quantified, they are not necessarily less important than the quantified costs. Additional unquantified costs are discussed in more detail in section 7.12; the most notable unquantified cost includes applications where methylene chloride is more effective, reducing labor time and wait time, and this analysis was unable to quantify these costs. Paint and coating removers are one product type where methylene chloride is likely the most effective product for many applications. In particular, alternatives to methylene chloride paint and coating removers in the furniture refinishing subset of the paint and coating removers use category may not be effective enough for this use to be commercially profitable. Because of these challenges, the final regulation allows methylene chloride use to continue, with WCPP requirements, for aerospace paint and coating removers from safety critical, corrosion-sensitive components of aircraft and spacecraft. For furniture refinishing, the final rule allows for 5 years of continued use of methylene chloride for refinishing of wooden pieces of artistic, cultural, or historic value, with additional worker protections during this interim period. The agency believes that this deferment of the prohibition of methylene chloride for furniture refinishing will allow the affected firms to identify technologically and economically feasible alternatives. However, furniture refinishing costs may increase if available alternatives greatly increase labor and costs of performing the work and some affected firms may ultimately discontinue this service as a result. Other firms may raise their prices for furniture refinishing as their costs increase. There would be a social cost equal to the loss of producer and consumer surplus due to the increased costs for furniture refinishing. In order to quantify this social cost, EPA would need to know the increase in price, the elasticity of demand, and the marginal costs. Since sufficient data are not available to develop these estimates, they are not quantified in the economic analysis.

It is possible to estimate that profits for the 4,899 furniture refinishing firms that use methylene chloride are approximately $63 million using the average estimated revenues per firm for NAICS 811420, Reupholstery and Furniture Repair ($338,525 is average revenue, calculated using the estimates presented in Table 3‑1) and an IRS ([2013](#_ENREF_28)) estimate for profit in this sector of 3.8% of sales. Profit is related to, but not the same as producer surplus. Producer surplus is generally larger than profit since producer surplus is the difference between total revenue and marginal cost and profit is the difference between total revenue and total cost. Total revenue for the 4,899 furniture refinishing firms that use methylene chloride is estimated to be $1.7 billion. Total revenue provides a measure of overall economic activity for these firms, but does not directly relate to the potential loss of producer and consumer surplus (i.e., social cost) from potential closures or price increases in the furniture refinishing industry.

EPA is unable to quantify the extent to which replacement of methylene chloride in some applications could result in other types of hazards (such as exposure to replacement chemicals or increases in fire risk). EPA has provided information on such potential hazards in the analysis of alternatives for individual uses, but cannot quantify the probability or magnitude of such costs.

Estimated Incremental Benefits

The health benefits monetized in this analysis include the cancer endpoints considered in EPA’s *Risk Evaluation for Methylene Chloride* ([2020i](#_ENREF_104)): (1) liver cancer and (2) lung cancer. Although the number of deaths from acute exposures avoided due to the options is unknown, some monetized benefits from potentially avoided deaths from acute inhalation exposures were estimated based on a pattern of historic deaths of commercial users of methylene chloride. The benefits for reducing other health risks associated with methylene chloride exposure were not estimated because they could not be quantified and monetized. Although certain benefits cannot be quantified, this does not necessarily mean that they are less important than the quantified benefits. The most notable unquantified benefits are reduced risk of other potential health effects of methylene chloride exposure. The risk evaluation identified these health effects, including effects on the central nervous system (CNS), liver, and immune system, as well as irritation/burns. Acute lethality in humans can result following methylene chloride inhalation, which is associated with CNS depressant effects. Additional CNS depressant effects include a loss of consciousness and respiratory depression resulting in irreversible coma, and hypoxia.

Table ES-6 and Table ES-7 present the low and high estimates for the total monetized cancer and potential deaths avoided benefits by option and use category, using 3 and 7 percent discount rates respectively. The low and high estimates use different estimates for the WTP for avoiding non-fatal liver cancer risk (see section 8.7). Benefits are presented in 2022 dollars in this document unless otherwise noted.

| Table ES-6: Total Monetized Benefits by Use Category and Option (Annualized over 20 years using 3 Percent Discount Rate, 2022$) | | | | |
| --- | --- | --- | --- | --- |
| Use Category | Low Estimate | | High Estimate | |
| Option 1  (Final Rule) | Option 2  (Alternative) | Option 1  (Final Rule) | Option 2  (Alternative) |
| Manufacturing | $12 | $12 | $12 | $12 |
| Import/Repackage | $1,154 | $1,154 | $1,167 | $1,167 |
| Processing as a reactant | $1,672 | $1,672 | $1,691 | $1,691 |
| Incorporation Into Formulation, Mixture, or Reaction Product | $3,095 | $3,095 | $3,129 | $3,129 |
| Waste Handling, Disposal, Treatment, and Recycling | $11,851 | $11,851 | $11,982 | $11,982 |
| Laboratory Use | $262 | $262 | $264 | $264 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | $21,490 | $21,519 | $21,758 | $21,728 |
| Aerospace Paint and Coating Removers | $29,567 | $29,584 | $29,912 | $29,895 |
| Cellulose Triacetate Film Production | $306 | $305 | $309 | $309 |
| Furniture Refinishing | $142,031 | $140,888 | $142,429 | $143,584 |
| Glues, Sealants, Adhesives, and Caulks | $192,742 | $451,772 | $456,786 | $194,882 |
| Vapor Degreasing | $1,472 | $1,472 | $1,487 | $1,487 |
| Liquid Cleaners and Degreasers | $215,497 | $215,497 | $217,823 | $217,823 |
| Aerosol Spray Cleaning/Degreasing | $1,186,021 | $1,186,021 | $1,198,823 | $1,198,823 |
| Paint and Coating Removers (Graffiti Removal) | $16,999 | $16,999 | $17,182 | $17,182 |
| Paint and Coating Removers (Bathtub Refinishing) | $5,224,687 | $5,224,687 | $5,224,942 | $5,224,942 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | $65,515 | $65,515 | $66,231 | $66,231 |
| Paint and Coating Removers (Art Restoration) | $3 | $3 | $3 | $3 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | $17,949 | $17,949 | $18,149 | $18,149 |
| Paint and Coating Removers (Professional Contracting) | $11,069,130 | $11,069,130 | $11,069,671 | $11,069,671 |
| Adhesive and Caulk Remover | $4,729,338 | $4,729,338 | $4,781,830 | $4,781,830 |
| Lithographic Printing Cleaner | $6,580 | $6,580 | $6,653 | $6,653 |
| Dry Cleaning and Spot Removers | $49,988 | $49,988 | $50,543 | $50,543 |
| Paint and Coatings | $5,449 | $5,449 | $5,509 | $5,509 |
| Lubricants and Greases | $868,955 | $868,955 | $878,600 | $878,600 |
| Cold Pipe Insulation | $716,754 | $716,754 | $724,709 | $724,709 |
| Anti-spatter Welding Aerosol | $210,472 | $210,472 | $212,808 | $212,808 |
| **Total** | **$24,788,990** | **$25,046,923** | **$25,144,404** | **$24,883,608** |

| Table ES-7: Total Monetized Benefits by Use Category and Option (Annualized over 20 years using 7 Percent Discount Rate, 2022$) | | | | |
| --- | --- | --- | --- | --- |
| Use Category | Low Estimate | | High Estimate | |
| Option 1  (Final Rule) | Option 2  (Alternative) | Option 1  (Final Rule) | Option 2  (Alternative) |
| Manufacturing | $6 | $6 | $6 | $6 |
| Import/Repackage | $543 | $543 | $550 | $550 |
| Processing as a reactant | $786 | $786 | $796 | $796 |
| Incorporation Into Formulation, Mixture, or Reaction Product | $1,456 | $1,456 | $1,474 | $1,474 |
| Waste Handling, Disposal, Treatment, and Recycling | $5,574 | $5,574 | $5,645 | $5,645 |
| Laboratory Use | $123 | $123 | $125 | $125 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | $10,108 | $10,121 | $10,251 | $10,237 |
| Aerospace Paint and Coating Removers | $13,907 | $13,913 | $14,091 | $14,085 |
| Cellulose Triacetate Film Production | $144 | $144 | $145 | $146 |
| Furniture Refinishing | $66,750 | $66,434 | $67,244 | $67,564 |
| Glues, Sealants, Adhesives, and Caulks | $71,615 | $212,492 | $215,208 | $72,530 |
| Vapor Degreasing | $694 | $694 | $703 | $703 |
| Liquid Cleaners and Degreasers | $100,112 | $100,112 | $101,333 | $101,333 |
| Aerosol Spray Cleaning/Degreasing | $550,979 | $550,979 | $557,701 | $557,701 |
| Paint and Coating Removers (Graffiti Removal) | $7,897 | $7,897 | $7,993 | $7,993 |
| Paint and Coating Removers (Bathtub Refinishing) | $5,080,545 | $5,080,545 | $5,080,679 | $5,080,679 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | $30,841 | $30,841 | $31,217 | $31,217 |
| Paint and Coating Removers (Art Restoration) | $1 | $1 | $1 | $1 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | $8,443 | $8,443 | $8,550 | $8,550 |
| Paint and Coating Removers (Professional Contracting) | $10,763,747 | $10,763,747 | $10,764,032 | $10,764,032 |
| Adhesive and Caulk Remover | $2,224,451 | $2,224,451 | $2,252,889 | $2,252,889 |
| Lithographic Printing Cleaner | $3,095 | $3,095 | $3,135 | $3,135 |
| Dry Cleaning and Spot Removers | $23,512 | $23,512 | $23,813 | $23,813 |
| Paint and Coatings | $2,563 | $2,563 | $2,596 | $2,596 |
| Lubricants and Greases | $408,714 | $408,714 | $413,939 | $413,939 |
| Cold Pipe Insulation | $337,126 | $337,126 | $341,436 | $341,436 |
| Anti-spatter Welding Aerosol | $98,996 | $98,996 | $100,261 | $100,261 |
| **Total** | **$19,812,726** | **$19,953,307** | **$20,005,814** | **$19,863,436** |

**Unquantified Benefits**

While the benefits analysis can only quantify and monetize reduced risk of cancer, reducing methylene chloride exposure would also result in reduced non-cancer effects. The risk assessment approach used in the *Risk Evaluation for Methylene Chloride* (EPA [2020i](#_ENREF_104)) identifies unreasonable risk and provides information needed to establish a protective level of exposures. However, the approach does not provide the continuous dose-response function needed to quantify changes in incidence of non-cancer effects in exposed populations, and therefore, while non-cancer benefits are expected from the rule, these effects cannot be quantitatively included in the benefit-cost analysis.

In the Risk Evaluation, EPA identified potential cancer and non-cancer human health risks (EPA [2020i](#_ENREF_104)). Risks from acute exposures include central nervous system risks such as central nervous system depression and a decrease in peripheral vision, each of which can lead to workplace accidents and which are precursors to more severe central nervous system effects such as incapacitation, loss of consciousness, and death. Section 8.9 of this economic analysis presents a qualitative discussion of the unquantified benefits related to fatty liver disease, nervous system effects, kidney toxicity, and reproductive and developmental hazards.

Estimated Incremental Net Benefits

Quantified net benefits are estimated by subtracting the total annualized quantified cost of the options (see Chapter 7) from the total annualized quantified benefits (see Chapter 8). Total quantified costs reflect costs of compliance with the options, including costs associated with complying with prohibition and WCPP requirements, for those uses where costs could be estimated. Total quantified benefits reflect the benefits of reduced risk for liver and lung cancer and reduced mortality risk from acute exposure to methylene chloride paint removers. Costs, benefits, and net benefits are presented in 2022 dollars in this document unless otherwise noted.

Table ES-8 and Table ES-9 present the net benefits by use category estimated using a 3 percent discount rate using the low and high benefits estimates, respectively. Table ES-10 and Table ES-11 present the net benefits by use category estimated using a 7 percent discount rate using the low and high benefits estimates, respectively. Table ES-12 summarizes the four net benefits estimates that were estimated.

Note that as discussed in Chapter 7, section 7.12, there are additional unquantified costs that affect all options. Similarly, Chapter 8 notes that there are also unquantified benefits. Therefore, it is not clear whether the monetized net benefits presented in the tables below under- or over-estimate the true social net benefits of the options.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table ES-8: Total 20-Year Annualized Net Benefits by Use Category and Option (Low Benefits Estimate, 3 Percent Discount Rate, 2022$) | | | | | | | | | | | | | | | |
| Use Category | | | Costs | | | Benefits | | | | | | Net Benefits | | | |
| Option 1  (Final Rule) | | Option 2  (Alternative) | Option 1  (Final Rule) | | | Option 2  (Alternative) | | | Option 1  (Final Rule) | | Option 2  (Alternative) | |
| Manufacturing | | | $208,710 | | $208,710 | $12 | | | $12 | | | ($208,698) | | ($208,698) | |
| Import/Repackage | | | $851,208 | | $851,208 | $1,154 | | | $1,154 | | | ($850,054) | | ($850,054) | |
| Processing as a reactant | | | $646,156 | | $646,156 | $1,672 | | | $1,672 | | | ($644,484) | | ($644,484) | |
| Waste Handling, Disposal, Treatment, and Recycling | | | $8,811,805 | | $8,811,805 | $11,851 | | | $11,851 | | | ($8,799,954) | | ($8,799,954) | |
| Laboratory Use | | | $281,701 | | $281,701 | $262 | | | $262 | | | ($281,439) | | ($281,439) | |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | | | $865,821 | | $166,273,554 | $21,490 | | | $21,519 | | | ($844,331) | | ($166,252,035) | |
| Aerospace Paint and Coating Removers | | | $2,169,416 | | $2,169,416 | $29,568 | | | $29,585 | | | ($2,139,847) | | ($2,139,830) | |
| Cellulose Triacetate Film Production | | | $12,485 | | $12,485 | $306 | | | $305 | | | ($12,179) | | ($12,180) | |
| Furniture Refinishing | | | $16,492,766 | | $16,492,766 | $142,063 | | | $140,920 | | | ($16,350,703) | | ($16,351,846) | |
| Glues, Sealants, Adhesives, and Caulks | | | $266,093 | | $347,570 | $193,663 | | | $452,693 | | | ($72,429) | | $105,123 | |
| Vapor Degreasing | | | $4,223,532 | | $4,223,532 | $1,472 | | | $1,472 | | | ($4,222,060) | | ($4,222,060) | |
| Liquid Cleaners and Degreasers | | | $56,393 | | $56,393 | $215,536 | | | $215,536 | | | $159,142 | | $159,142 | |
| Aerosol Spray Cleaning/Degreasing | | | $1,061,122 | | $1,061,122 | $1,186,124 | | | $1,186,124 | | | $125,001 | | $125,001 | |
| Paint and Coating Removers (graffiti Removal) | | | $837 | | $837 | $17,000 | | | $17,000 | | | $16,163 | | $16,163 | |
| Paint and Coating Removers (Bathtub Refinishing) | | | $3,475 | | $3,475 | $5,224,690 | | | $5,224,690 | | | $5,221,215 | | $5,221,215 | |
| Paint and Coating Removers (Automotive Repair and Refinishing) | | | $49,205 | | $49,205 | $65,554 | | | $65,554 | | | $16,349 | | $16,349 | |
| Paint and Coating Removers (Art Restoration) | | | $317 | | $317 | $3 | | | $3 | | | ($314) | | ($314) | |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | | | $10,605 | | $10,605 | $17,958 | | | $17,958 | | | $7,353 | | $7,353 | |
| Paint and Coating Removers (Professional Contracting) | | | $4,958 | | $4,958 | $11,069,134 | | | $11,069,134 | | | $11,064,176 | | $11,064,176 | |
| Adhesive and Caulk Remover | | | $32,778 | | $32,778 | $4,729,364 | | | $4,729,364 | | | $4,696,586 | | $4,696,586 | |
| Lithographic Printing Cleaner | | | $19,307 | | $19,307 | $6,631 | | | $6,631 | | | ($12,675) | | ($12,675) | |
| Dry Cleaning and Spot Removers | | | $12,882 | | $12,882 | $50,001 | | | $50,001 | | | $37,119 | | $37,119 | |
| Paint and Coatings | | | $553,868 | | $553,868 | $7,022 | | | $7,022 | | | ($546,846) | | ($546,846) | |
| Lubricants and Greases | | | $143,039 | | $143,039 | $869,032 | | | $869,032 | | | $725,993 | | $725,993 | |
| Cold Pipe Insulation | | | $64,878 | | $64,878 | $716,766 | | | $716,766 | | | $651,888 | | $651,888 | |
| Anti-spatter Welding Aerosol | | | $103,209 | | $103,209 | $210,664 | | | $210,664 | | | $107,454 | | $107,454 | |
| **Total** | | | **$36,946,566** | | **$202,435,776** | **$24,788,990** | | | **$25,046,923** | | | **($12,157,576)** | | **($177,388,853)** | |
| Note: Costs and benefits for processors reformulating their methylene chloride products are accounted for under the use categories of the products being reformulated. | | | | | | | | | | | | | | | |
| Table ES-9: Total 20-Year Annualized Net Benefits by Use Category and Option (High Benefits Estimate, 3 Percent Discount Rate, 2022$) | | | | | | | | | | | | | | | |
| Use Category | | | Costs | | | Benefits | | | | | Net Benefits | | | | |
| Option 1  (Final Rule) | | Option 2  (Alternative) | Option 1  (Final Rule) | | Option 2  (Alternative) | | | Option 1  (Final Rule) | | | Option 2  (Alternative) | |
| Manufacturing | | | $208,710 | | $208,710 | $12 | | $12 | | | ($208,698) | | | ($208,698) | |
| Import/Repackage | | | $851,208 | | $851,208 | $1,167 | | $1,167 | | | ($850,041) | | | ($850,041) | |
| Processing as a reactant | | | $646,156 | | $646,156 | $1,691 | | $1,691 | | | ($644,466) | | | ($644,466) | |
| Waste Handling, Disposal, Treatment, and Recycling | | | $8,811,805 | | $8,811,805 | $11,982 | | $11,982 | | | ($8,799,823) | | | ($8,799,823) | |
| Laboratory Use | | | $281,701 | | $281,701 | $264 | | $264 | | | ($281,436) | | | ($281,436) | |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | | | $865,821 | | $166,273,554 | $21,758 | | $21,728 | | | ($844,063) | | | ($166,251,825) | |
| Aerospace Paint and Coating Removers | | | $2,169,416 | | $2,169,416 | $29,914 | | $29,897 | | | ($2,139,502) | | | ($2,139,519) | |
| Cellulose Triacetate Film Production | | | $12,485 | | $12,485 | $309 | | $309 | | | ($12,176) | | | ($12,176) | |
| Furniture Refinishing | | | $16,492,766 | | $16,492,766 | $142,462 | | $143,617 | | | ($16,350,304) | | | ($16,349,149) | |
| Glues, Sealants, Adhesives, and Caulks | | | $266,093 | | $347,570 | $457,717 | | $195,813 | | | $191,625 | | | ($151,757) | |
| Vapor Degreasing | | | $4,223,532 | | $4,223,532 | $1,487 | | $1,487 | | | ($4,222,044) | | | ($4,222,044) | |
| Liquid Cleaners and Degreasers | | | $56,393 | | $56,393 | $217,862 | | $217,862 | | | $161,469 | | | $161,469 | |
| Aerosol Spray Cleaning/Degreasing | | | $1,061,122 | | $1,061,122 | $1,198,926 | | $1,198,926 | | | $137,804 | | | $137,804 | |
| Paint and Coating Removers (graffiti Removal) | | | $837 | | $837 | $17,183 | | $17,183 | | | $16,346 | | | $16,346 | |
| Paint and Coating Removers (Bathtub Refinishing) | | | $3,475 | | $3,475 | $5,224,945 | | $5,224,945 | | | $5,221,470 | | | $5,221,470 | |
| Paint and Coating Removers (Automotive Repair and Refinishing) | | | $49,205 | | $49,205 | $66,271 | | $66,271 | | | $17,066 | | | $17,066 | |
| Paint and Coating Removers (Art Restoration) | | | $317 | | $317 | $3 | | $3 | | | ($314) | | | ($314) | |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | | | $10,605 | | $10,605 | $18,157 | | $18,157 | | | $7,552 | | | $7,552 | |
| Paint and Coating Removers (Professional Contracting) | | | $4,958 | | $4,958 | $11,069,675 | | $11,069,675 | | | $11,064,718 | | | $11,064,718 | |
| Adhesive and Caulk Remover | | | $32,778 | | $32,778 | $4,781,856 | | $4,781,856 | | | $4,749,077 | | | $4,749,077 | |
| Lithographic Printing Cleaner | | | $19,307 | | $19,307 | $6,705 | | $6,705 | | | ($12,602) | | | ($12,602) | |
| Dry Cleaning and Spot Removers | | | $12,882 | | $12,882 | $50,556 | | $50,556 | | | $37,674 | | | $37,674 | |
| Paint and Coatings | | | $553,868 | | $553,868 | $7,100 | | $7,100 | | | ($546,768) | | | ($546,768) | |
| Lubricants and Greases | | | $143,039 | | $143,039 | $878,677 | | $878,677 | | | $735,638 | | | $735,638 | |
| Cold Pipe Insulation | | | $64,878 | | $64,878 | $724,722 | | $724,722 | | | $659,844 | | | $659,844 | |
| Anti-spatter Welding Aerosol | | | $103,209 | | $103,209 | $213,002 | | $213,002 | | | $109,792 | | | $109,792 | |
| **Total** | | | **$36,946,566** | | **$202,435,776** | **$25,144,404** | | **$24,883,608** | | | **($11,802,162)** | | | **($177,552,167)** | |
| Note: Costs and benefits for processors reformulating their methylene chloride products are accounted for under the use categories of the products being reformulated. | | | | | | | | | | | | | | | |
| Table ES-10: Total 20-Year Annualized Net Benefits by Use Category and Option (Low Benefits Estimate, 7 Percent Discount Rate, 2022$) | | | | | | | | | | | | | | | |
| Use Category | | | Costs | | | Benefits | | | | | Net Benefits | | | | |
| Option 1  (Final Rule) | | Option 2  (Alternative) | Option 1  (Final Rule) | | Option 2  (Alternative) | | | Option 1  (Final Rule) | | | Option 2  (Alternative) | |
| Manufacturing | | | $207,431 | | $207,431 | $6 | | $6 | | | ($207,425) | | | ($207,425) | |
| Import/Repackage | | | $843,084 | | $843,084 | $543 | | $543 | | | ($842,542) | | | ($842,542) | |
| Processing as a reactant | | | $640,793 | | $640,793 | $786 | | $786 | | | ($640,007) | | | ($640,007) | |
| Waste Handling, Disposal, Treatment, and Recycling | | | $8,753,047 | | $8,753,047 | $5,574 | | $5,574 | | | ($8,747,473) | | | ($8,747,473) | |
| Laboratory Use | | | $279,477 | | $279,477 | $123 | | $123 | | | ($279,354) | | | ($279,354) | |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | | | $858,085 | | $227,704,065 | $10,108 | | $10,121 | | | ($847,977) | | | ($227,693,943) | |
| Aerospace Paint and Coating Removers | | | $2,149,325 | | $2,149,325 | $13,908 | | $13,914 | | | ($2,135,417) | | | ($2,135,411) | |
| Cellulose Triacetate Film Production | | | $12,368 | | $12,368 | $144 | | $144 | | | ($12,224) | | | ($12,224) | |
| Furniture Refinishing | | | $16,664,027 | | $16,664,027 | $66,765 | | $66,449 | | | ($16,597,262) | | | ($16,597,578) | |
| Glues, Sealants, Adhesives, and Caulks | | | $250,560 | | $464,928 | $72,048 | | $212,925 | | | ($178,512) | | | ($252,003) | |
| Vapor Degreasing | | | $5,966,075 | | $5,966,075 | $694 | | $694 | | | ($5,965,381) | | | ($5,965,381) | |
| Liquid Cleaners and Degreasers | | | $76,768 | | $76,768 | $100,130 | | $100,130 | | | $23,362 | | | $23,362 | |
| Aerosol Spray Cleaning/Degreasing | | | $1,451,930 | | $1,451,930 | $551,027 | | $551,027 | | | ($900,903) | | | ($900,903) | |
| Paint and Coating Removers (graffiti Removal) | | | $1,138 | | $1,138 | $7,897 | | $7,897 | | | $6,760 | | | $6,760 | |
| Paint and Coating Removers (Bathtub Refinishing) | | | $4,724 | | $4,724 | $5,080,546 | | $5,080,546 | | | $5,075,822 | | | $5,075,822 | |
| Paint and Coating Removers (Automotive Repair and Refinishing) | | | $66,917 | | $66,917 | $30,859 | | $30,859 | | | ($36,057) | | | ($36,057) | |
| Paint and Coating Removers (Art Restoration) | | | $432 | | $432 | $2 | | $2 | | | ($430) | | | ($430) | |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | | | $14,421 | | $14,421 | $8,446 | | $8,446 | | | ($5,975) | | | ($5,975) | |
| Paint and Coating Removers (Professional Contracting) | | | $6,740 | | $6,740 | $10,763,749 | | $10,763,749 | | | $10,757,010 | | | $10,757,010 | |
| Adhesive and Caulk Remover | | | $44,581 | | $44,581 | $2,224,463 | | $2,224,463 | | | $2,179,882 | | | $2,179,882 | |
| Lithographic Printing Cleaner | | | $25,826 | | $25,826 | $3,119 | | $3,119 | | | ($22,707) | | | ($22,707) | |
| Dry Cleaning and Spot Removers | | | $17,488 | | $17,488 | $23,518 | | $23,518 | | | $6,030 | | | $6,030 | |
| Paint and Coatings | | | $739,614 | | $739,614 | $3,303 | | $3,303 | | | ($736,311) | | | ($736,311) | |
| Lubricants and Greases | | | $194,965 | | $194,965 | $408,750 | | $408,750 | | | $213,786 | | | $213,786 | |
| Cold Pipe Insulation | | | $88,694 | | $88,694 | $337,132 | | $337,132 | | | $248,438 | | | $248,438 | |
| Anti-spatter Welding Aerosol | | | $139,038 | | $139,038 | $99,086 | | $99,086 | | | ($39,952) | | | ($39,952) | |
| **Total** | | | **$39,497,548** | | **$266,557,895** | **$19,812,726** | | **$19,953,307** | | | **($19,684,821)** | | | **($246,604,588)** | |
| Note: Costs and benefits for processors reformulating their methylene chloride products are accounted for under the use categories of the products being reformulated. | | | | | | | | | | | | | | | |
| Table ES-11: Total 20-Year Annualized Net Benefits by Use Category and Option (High Benefits Estimate, 7 Percent Discount Rate, 2022$) | | | | | | | | | | | | | | | |
| Use Category | | | Costs | | | Benefits | | | | | Net Benefits | | | | |
| Option 1  (Final Rule) | | Option 2  (Alternative) | Option 1  (Final Rule) | | Option 2  (Alternative) | | | Option 1  (Final Rule) | | | Option 2  (Alternative) | |
| Manufacturing | | | $207,431 | | $207,431 | $6 | | $6 | | | ($207,425) | | | ($207,425) | |
| Import/Repackage | | | $843,084 | | $843,084 | $550 | | $550 | | | ($842,535) | | | ($842,535) | |
| Processing as a reactant | | | $640,793 | | $640,793 | $796 | | $796 | | | ($639,997) | | | ($639,997) | |
| Waste Handling, Disposal, Treatment, and Recycling | | | $8,753,047 | | $8,753,047 | $5,645 | | $5,645 | | | ($8,747,402) | | | ($8,747,402) | |
| Laboratory Use | | | $279,477 | | $279,477 | $125 | | $125 | | | ($279,352) | | | ($279,352) | |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | | | $858,085 | | $227,704,065 | $10,251 | | $10,237 | | | ($847,834) | | | ($227,693,828) | |
| Aerospace Paint and Coating Removers | | | $2,149,325 | | $2,149,325 | $14,092 | | $14,085 | | | ($2,135,233) | | | ($2,135,239) | |
| Cellulose Triacetate Film Production | | | $12,368 | | $12,368 | $145 | | $146 | | | ($12,222) | | | ($12,222) | |
| Furniture Refinishing | | | $16,664,027 | | $16,664,027 | $67,260 | | $67,580 | | | ($16,596,767) | | | ($16,596,447) | |
| Glues, Sealants, Adhesives, and Caulks | | | $250,560 | | $464,928 | $215,647 | | $72,969 | | | ($34,913) | | | ($391,959) | |
| Vapor Degreasing | | | $5,966,075 | | $5,966,075 | $703 | | $703 | | | ($5,965,373) | | | ($5,965,373) | |
| Liquid Cleaners and Degreasers | | | $76,768 | | $76,768 | $101,351 | | $101,351 | | | $24,584 | | | $24,584 | |
| Aerosol Spray Cleaning/Degreasing | | | $1,451,930 | | $1,451,930 | $557,750 | | $557,750 | | | ($894,181) | | | ($894,181) | |
| Paint and Coating Removers (graffiti Removal) | | | $1,138 | | $1,138 | $7,994 | | $7,994 | | | $6,856 | | | $6,856 | |
| Paint and Coating Removers (Bathtub Refinishing) | | | $4,724 | | $4,724 | $5,080,680 | | $5,080,680 | | | $5,075,956 | | | $5,075,956 | |
| Paint and Coating Removers (Automotive Repair and Refinishing) | | | $66,917 | | $66,917 | $31,236 | | $31,236 | | | ($35,681) | | | ($35,681) | |
| Paint and Coating Removers (Art Restoration) | | | $432 | | $432 | $2 | | $2 | | | ($430) | | | ($430) | |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | | | $14,421 | | $14,421 | $8,554 | | $8,554 | | | ($5,867) | | | ($5,867) | |
| Paint and Coating Removers (Professional Contracting) | | | $6,740 | | $6,740 | $10,764,034 | | $10,764,034 | | | $10,757,294 | | | $10,757,294 | |
| Adhesive and Caulk Remover | | | $44,581 | | $44,581 | $2,252,901 | | $2,252,901 | | | $2,208,320 | | | $2,208,320 | |
| Lithographic Printing Cleaner | | | $25,826 | | $25,826 | $3,159 | | $3,159 | | | ($22,667) | | | ($22,667) | |
| Dry Cleaning and Spot Removers | | | $17,488 | | $17,488 | $23,819 | | $23,819 | | | $6,331 | | | $6,331 | |
| Paint and Coatings | | | $739,614 | | $739,614 | $3,345 | | $3,345 | | | ($736,269) | | | ($736,269) | |
| Lubricants and Greases | | | $194,965 | | $194,965 | $413,976 | | $413,976 | | | $219,011 | | | $219,011 | |
| Cold Pipe Insulation | | | $88,694 | | $88,694 | $341,442 | | $341,442 | | | $252,748 | | | $252,748 | |
| Anti-spatter Welding Aerosol | | | $139,038 | | $139,038 | $100,353 | | $100,353 | | | ($38,685) | | | ($38,685) | |
| **Total** | | | **$39,497,548** | | **$266,557,895** | **$20,005,814** | | **$19,863,436** | | | **($19,491,734)** | | | **($246,694,460)** | |
| Note: Costs and benefits for processors reformulating their methylene chloride products are accounted for under the use categories of the products being reformulated. | | | | | | | | | | | | | | | |
| Table ES-12: Total 20-Year Annualized Net Benefits by Option, (Millions, 2022$) | | | | | | | | | | | | | | |
| Estimate | Costs | | | Benefits | | | | | | Net Benefits | | | | |
| Option 1  (Final Rule) | Option 2  (Alternative) | | Option 1  (Final Rule) | | | Option 2  (Alternative) | | | Option 1  (Final Rule) | | | Option 2  (Alternative) | |
| Low Benefits, 3 Percent Discount Rate | $37 | $202 | | $25 | | | $25 | | | ($12) | | | ($177) | |
| High Benefits, 3 Percent Discount Rate | $37 | $202 | | $25 | | | $25 | | | ($12) | | | ($178) | |
| Low Benefits, 7 Percent Discount Rate | $39 | $267 | | $20 | | | $20 | | | ($20) | | | ($247) | |
| High Benefits, 7 Percent Discount Rate | $39 | $267 | | $20 | | | $20 | | | ($19) | | | ($247) | |

Environmental Justice Impacts

EPA’s “Technical Guidance for Assessing Environmental Justice in Regulatory Analysis[[2]](#footnote-4)” provides recommendations that encourage analysts to conduct the highest quality analysis feasible, recognizing that data limitations, time and resource constraints, and analytic challenges will vary by media and circumstance ([EPA 2016b](#_ENREF_89)). This environmental justice (EJ) analysis presents information about the facilities, workforce, and communities potentially affected by the regulatory options under current conditions, before the rule goes into effect. It draws on publicly available data provided by EPA, U.S. Census, and CDC, including the Toxics Release Inventory (TRI), EPA Enforcement and Compliance History Online (ECHO), National Air Toxics Assessment (NATA), the American Community Survey, and the Behavioral Risk Factor Surveillance System.

The purpose of the EJ analysis (see section 10.6) is to characterize the baseline conditions faced by communities and workers affected by the regulation to identify the potential for disproportionate impacts on minority and low-income populations. The EJ analysis first characterizes the average demographic characteristics of communities near all methylene chloride facilities compared to national and rural averages. The baseline characterization across all facilities establishes typical demographics near these facilities and provides a useful point of departure for examining specific subsets of facilities of special interest. The analysis then delves into the characteristics of communities near facilities associated with two COUs, processing and industrial use of hydrofluorocarbons (HFCs), and chemical manufacturing. The analysis also presents an assessment of worker demographics for each of these COUs. For one of the use categories—processing and industrial use of HFCs—since only four facilities are affected by the rule, EPA is able to provide a granular assessment of the characteristics of these facilities and the communities where they are located.

The analysis also presents sociodemographic characteristics for eleven communities near facilities that pose potential risk to individuals living in close proximity due to non-zero air emissions of methylene chloride according to TRI data from 2018-2020. Demographic information for these fenceline communities is presented separately for three facilities that will face WCPP requirements under the rule and the additional eight facilities anticipated to face prohibition under the rule.

The analysis did not suggest any potential disproportionate risks in the national workforce in industries affected by the chemical manufacturing or hydrofluorocarbon industries. However, the lack of location-specific data on these use categories could mask geographic heterogeneity in workforce sociodemographic characteristics, therefore this analysis is not conclusive.

Data limitations prevent EPA from conducting a more comprehensive EJ analysis that would identify the incremental impacts of the regulatory options and assess the extent to which they mitigate or exacerbate any disproportionate impacts in communities with environmental justice concerns. Uncertainties include the sociodemographic characteristics of the specific individuals affected by the use categories and the substitute technologies and practices that would be adopted at regulated entities in response to the rule. While the regulatory options are anticipated to eliminate unreasonable risk from exposure to methylene-chloride, EPA is not able to quantify the distribution of the change in risk across affected workers, communities, or demographic groups. EPA is also unable to quantify the changes in risk to workers, communities, and demographic groups from non-methylene-chloride-using technologies or practices that firms may adopt in response to the regulation to determine whether any such changes could pose environmental justice concerns.

Table ES-13 presents average information on communities surrounding all existing facilities – as identified in EPA’s Chemical Data Reporting (CDR) ([EPA 2022a](#_ENREF_107)) and National Emissions Inventory (NEI) ([EPA 2020a](#_ENREF_96)) – likely to be affected by the regulation compared to both the overall national average and the national average for rural areas. The analysis uses socioeconomic and demographic data from the American Community Survey (ACS) 5-year data release for 2020 (the most recent year available). The values in the last three columns reflect population-weighted averages across the Census block groups within 1, 3 and 5 miles of each facility. The table presents rural in addition to overall national statistics for comparison because 4,554 of the 6,460 facilities are located in rural communities. For the purposes of this analysis, EPA considers a facility to be in a rural community if 50 percent or more of the population estimated to live within 3 miles of the facility is not located in an urban block group.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table ES-13: Demographics of Communities within 1-, 3-, and 5-mile radii of Methylene Chloride Facilities, population weighted averages | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,994 | $51,878 | $71,242 | $76,408 | $78,585 |
| White | 70.4% | 87.6% | 59.7% | 59.6% | 63.2% |
| Black | 12.6% | 5.8% | 13.2% | 12.9% | 13.0% |
| American Indian | 0.8% | 1.7% | 0.6% | 0.6% | 0.6% |
| Asian | 5.6% | 1.2% | 10.4% | 10.3% | 9.4% |
| Pacific Islander | 0.2% | 0.1% | 0.2% | 0.2% | 0.2% |
| Other | 10.3% | 3.6% | 15.9% | 16.3% | 13.6% |
| Hispanic | 18.2% | 2.4% | 27.4% | 29.0% | 23.8% |
| 2x Poverty Line | 29.8% | 26.0% | 35.2% | 32.0% | 30.1% |
| Below Poverty Line | 12.8% | 9.6% | 16.5% | 14.3% | 13.3% |
| NATA Cancer Risk |  |  | 27 | 27 | 27 |
| NATA Respiratory Hazard Score |  |  | 0.35 | 0.34 | 0.34 |
| Total Population |  |  | 16,789,505 | 157,932,671 | 310,814,558 |

Table ES-13 indicates that in general, communities within 1, 3, and 5 miles of methylene chloride facilities affected by this regulation have a much higher share of Hispanic and Asian-American persons, as well as persons of a race other than those listed. The data also suggests a lower share of White persons than either the overall national average or the rural national average. The share of Black persons living in these communities is similar to the overall national average but higher than the rural national average. Median household incomes are higher in these communities compared to the national average, while poverty rates are significantly higher in communities within 1 and 3 miles of such facilities, and similar in communities within 5 miles of such facilities.

Estimated Small Business Impacts

Table ES-14 presents a summary of the small business impacts overall and for each of the use categories where small business impacts were estimated.

| Table ES-14: Summary of Small Business Impacts | | | | | |
| --- | --- | --- | --- | --- | --- |
| Use Category | Number of Small Firms | **Average Cost Per Small Firm** | Number and Percent of Firms by Cost-Revenue Impact Threshold | | |
| <1% | 1-3% | >3% |
| Manufacturing | 2 | $15,928 | 2 (100%) | - | - |
| Import/Repackage | 4 | $26,840 | 2 (60%) | 1 (20%) | 1 (20%) |
| Processing as a reactant | 5 | $19,502 | 5 (100%) | - | - |
| Incorporation Into Formulation, Mixture, or Reaction Product | 37 | $14,206 | 32 (87%) | 3 (8%) | 2 (5%) |
| Waste Handling, Disposal, Treatment, and Recycling | 963 | $8,023 | 591 (61%) | 229 (24%) | 143 (15%) |
| Laboratory Use | 52 | $4,991 | 31 (60%) | 12 (23%) | 9 (17%) |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | 7 | $19,502 | 7 (100%) | - | - |
| Aerospace Paint and Coating Removers | 270 | $7,902 | 61 (23%) | 83 (31%) | 126 (47%) |
| Cellulose Triacetate Film Production | - | - | - | - | - |
| Furniture Refinishing | 4,829 | $3,401 | 2,630 (54%) | 1,339 (28%) | 861 (18%) |
| Glues, Sealants, Adhesives, and Caulks | 3,913 | $8 | 3,913 (100%) | - | - |
| Vapor Degreasing | 10 | $350,946 | 3 (30%) | 1 (10%) | 6 (60%) |
| Liquid Cleaners and Degreasers | 6,836 | $8 | 6,836 (100%) | - | - |
| Aerosol Spray Cleaning/Degreasing | 166,254 | $8 | 166,254 (100%) | - | - |
| Paint and Coating Removers (graffiti Removal) | 88 | $8 | 88 (100%) | - | - |
| Paint and Coating Removers (Bathtub Refinishing) | 430 | $8 | 430 (100%) | - | - |
| Paint and Coating Removers (Automotive Repair and Refinishing) | 5,785 | $8 | 5,785 (100%) | - | - |
| Paint and Coating Removers (Art Restoration) | 37 | $8 | 37 (100%) | - | - |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | 1,234 | $8 | 1,234 (100%) | - | - |
| Paint and Coating Removers (Professional Contracting) | 613 | $8 | 613 (100%) | - | - |
| Adhesive and Caulk Remover | 3,913 | $8 | 3,913 (100%) | - | - |
| Lithographic Printing Cleaner | 172 | $8 | 172 (100%) | - | - |
| Dry Cleaning and Spot Removers | 1,383 | $8 | 1,383 (100%) | - | - |
| Paint and Coatings | 119 | $8 | 119 (100%) | - | - |
| Lubricants and Greases | 19,170 | $8 | 19,170 (100%) | - | - |
| Cold Pipe Insulation | 10,471 | $8 | 10,471 (100%) | - | - |
| Anti-spatter Welding Aerosol | 5,854 | $8 | 5,854 (100%) | - | - |
| **All Use Categories** | **232,451** | **$141** | **229,635 (99%)** | **1,668 (1%)** | **1,148 (0.5%)** |

There are no methylene chloride manufacturers or entities using methylene chloride in cellulose triacetate film production that are small entities according to the U.S. Small Business Administration (SBA) small business thresholds. Except for vapor degreasing and furniture refinishing, no cost impacts beyond rule familiarization are estimated for users of products that contain methylene chloride who will need to switch to alternative products that do not contain methylene chloride (*e.g.,* methylene chloride aerosol spray cleaners and degreasers)*.* Chapter 5 demonstrates that alternative products with similar costs and efficacy to methylene chloride products are generally available. Alternative products that are drop-in substitutes (i.e., requiring no changes by the user in how the product is used) were generally available. However, in some cases some effort might be required by firms using methylene chloride products to identify suitable alternatives, test them for their desired applications, learn how to use them safely and effectively, and implement new processes for using the alternative products. The information to estimate how often these costs might be incurred or what the specific costs would be per-user or per-firm when they are incurred is not available. Therefore, EPA is unable to consider these costs quantitatively in the FRFA or Economic Analysis.

As noted above, alternatives to methylene chloride paint and coating removers in the furniture refinishing subset of the paint and coating removers use category may not be effective enough for this use to be commercially profitable. Because of these challenges, the final regulation allows methylene chloride use to continue, with WCPP requirements, for aerospace paint and coating removers for safety critical, corrosion-sensitive components of aircraft and spacecraft. For furniture refinishing, the final rule allows for 5 years of continued use of methylene chloride for refinishing of wooden pieces of artistic, cultural, or historic value, with additional worker protections during this interim period. The agency believes that this deferment of the prohibition of methylene chloride for furniture refinishing will allow the affected firms to identify technologically and economically feasible alternatives. However, furniture refinishing costs may increase if available alternatives greatly increase labor and costs of performing the work and some affected firms may ultimately discontinue this service as a result. Other firms may raise their prices for furniture refinishing as their costs increase. The direct impact on the affected firms would be the loss of producer surplus due to the increased costs for furniture refinishing. In order to quantify this cost, EPA would need to know the increase in price, the elasticity of demand, and the marginal costs. Since sufficient data are not available to develop these estimates, they are not quantified in the small business impact analysis.

It is possible to estimate that profits for the 4,899 furniture refinishing firms that use methylene chloride are approximately $63 million using the average estimated revenues per firm for NAICS 811420, Reupholstery and Furniture Repair ($338,525 is average revenue, calculated using the estimates presented in Table 3‑1) and an IRS ([2013](#_ENREF_28)) estimate for profit in this sector of 3.8% of sales. Profit is related to, but not the same as producer surplus. Producer surplus is generally larger than profit since producer surplus is the difference between total revenue and marginal cost and profit is the difference between total revenue and total cost. Total revenue for the 4,899 furniture refinishing firms that use methylene chloride is estimated to be $1.7 billion. Total revenue provides a measure of overall economic activity for these firms, but does not directly relate to the potential loss of producer from potential closures or price increases in the furniture refinishing industry.

# Introduction

The U.S. Environmental Protection Agency (EPA) is finalizing a rule under section 6(a) of the Toxic Substances Control Act (TSCA) for methylene chloride to address the unreasonable risk of injury to human health under its conditions of use (COUs). This report estimates and evaluates the costs, benefits, and impacts expected to result from the rule to regulate manufacture (including import), processing, distribution in commerce, industrial and commercial use, and disposal of methylene chloride. EPA is finalizing the regulation under the authority of TSCA section 6(a) after completing a risk evaluation under TSCA section 6(b) and determining that the chemical substance presents an unreasonable risk of injury to human health. The rule, “Regulation of Methylene Chloride Under TSCA Section 6(a),” addresses the unreasonable risk that EPA determined is presented by methylene chloride under the COUs. These COUs are presented below in Table 1‑1. Table 1‑1 also lists the use categories and defines how the economic analysis use categories map to the COUs. The use categories are the categories of methylene chloride use that are considered in the economic analysis.[[3]](#footnote-5)

| Table 1‑1: Use Categories Considered in the Economic Analysis Mapped to the Conditions of Use (COUs) in the Risk Evaluation | |
| --- | --- |
| Use Category | Condition of Use (COU) |
| Manufacturing | Manufacturing (Domestic manufacturing) |
| Import/Repackage | Manufacturing (Import) |
| Processing: repackaging |
| Processing as a Reactant | Processing: processing as a reactant |
| Incorporation Into Formulation, Mixture, or Reaction Product | Processing: incorporation into a formulation, mixture, or reaction product |
| Industrial and commercial use as solvent that becomes part of a formulation or mixture |
| Waste Handling, Disposal, Treatment, and Recycling | Processing: recycling |
| Disposal |
| Laboratory Use | Industrial and commercial use as a laboratory chemical |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Industrial and commercial use as a processing aid |
| Industrial and commercial use as a solvent that becomes part of a formulation or mixture, where that formulation or mixture will be used inside a manufacturing process, and the solvent (methylene chloride) will be reclaimed |
| Industrial and commercial use for plastic and rubber products manufacturing |
| Industrial or commercial use as a bonding agent for solvent welding |
| Aerospace Paint and Coating Removers | Industrial and commercial use as a paint and coating remover from safety critical, corrosion-sensitive components of aircraft and spacecraft |
| Cellulose Triacetate Film Production | Industrial and commercial use in cellulose triacetate film production |
| Furniture Refinishing | Industrial and commercial use in paint and coating removal in furniture refinishing for intricate or historically significant wood pieces |
| Glues, Sealants, Adhesives, and Caulks | Industrial and commercial use in adhesives and sealants in aircraft, space vehicle, and turbine applications for structural and safety critical non-structural applications |
| Industrial and commercial use in adhesives, sealants and caulks (except adhesives and sealants in aircraft, space vehicle, and turbine applications for structural and safety critical non-structural applications) |
| Consumer use in adhesives and sealants |
| Consumer use in arts, crafts, and hobby materials glue |
| Vapor Degreasing | Industrial and commercial use as solvent for batch vapor degreasing |
| Industrial and commercial use as solvent for in-line vapor degreasing |
| Liquid Cleaners and Degreasers | Industrial and commercial use as solvent for cold cleaning |
| Industrial and commercial use in metal non-aerosol degreasers |
| Industrial and commercial use in non-aerosol degreasers and cleaners |
| Aerosol Spray Cleaning/Degreasing | Industrial and commercial use as a solvent for aerosol spray degreaser/cleaner |
| Industrial and commercial use in metal aerosol degreasers |
| Industrial and commercial use in automotive care products (interior car care) |
| Industrial and commercial use in automotive care products (degreasers) |
| Industrial and commercial use in aerosol degreasers and cleaners |
| Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner1 |
| Consumer use as solvent in aerosol degreasers/cleaners |
| Consumer use in metal degreasers |
| Consumer use in automotive care products (degreasers) |
| Consumer use in carbon removers and other brush cleaners1 |
| Paint and Coating Removers (except aerospace and furniture refinishing) | Industrial and commercial use in paint and coating removers (except select wood furniture and safety critical, corrosion-sensitive components of aircraft and spacecraft) |
| Adhesive and Caulk Remover | Industrial and commercial use in adhesive and caulk removers |
| Consumer use in adhesive and caulk removers |
| Lithographic Printing Cleaner | Industrial and commercial use in lithographic printing plate cleaner |
| Dry Cleaning and Spot Removers | Industrial and commercial use in spot removers for apparel and textiles |
| Paint and Coatings | Industrial and commercial use in paints and coatings |
| Lubricants and Greases | Industrial and commercial use in liquid lubricants and greases |
| Industrial and commercial use in spray lubricants and greases |
| Consumer use in lubricants and greases |
| Cold Pipe Insulation | Industrial and commercial use in cold pipe insulations |
| Consumer use in cold pipe insulation |
| Anti-spatter Welding Aerosol | Industrial and commercial use as anti-spatter welding aerosol |
| Consumer use in an anti-spatter welding aerosol |
| Uses believed to be inactive or fully overlap with other conditions of use | |
| Toys, Playground, and Supporting Equipment | Industrial and commercial use in toys, playground and sporting equipment |
| Wood Floor and Brush Cleaners | Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner1 |
| Consumer use in carbon removers and other brush cleaners1 |
| Consumer use in brush cleaners for paints and coatings2 |
| Functional Fluids | Industrial and commercial use in automotive care products (functional fluids for air conditioners2 |
| Consumer use in automotive care products (functional fluids for air conditioners)2 |
| Propellant and Blowing Agent | Industrial and commercial use as a propellant and blowing agent3 |
| Finishing Products for Fabric, Textiles and Leather | Industrial and commercial use in finishing products for fabric, textiles and leather4 |
| Industrial and commercial use in apparel and footwear care products4 |
| Electrical Equipment, Appliance, and Component Manufacturing | Industrial and commercial use for electrical equipment, appliance, and component manufacturing4 |
| Oil and Gas Drilling | Industrial and commercial use for oil and gas drilling, extraction, and support activities4 |

## Background

Methylene chloride (CASRN 75-09-2), also known as dichloromethane, is a colorless liquid with a penetrating, ether-like odor. It is produced by the direct reaction of methane with chlorine at either high temperatures or low temperatures under catalytic or photolytic conditions. The principal uses for methylene chloride have been in paint strippers and removers, as a propellant in aerosols, in the manufacture of drugs, pharmaceuticals, film coatings, electronics, and polyurethane foam, and as a metal-cleaning solvent ([EPA 2011b](#_ENREF_84)).

EPA’s *Risk Evaluation for Methylene Chloride* identified six non-cancer adverse health effects: effects from acute/short-term exposure, liver effects, immune system effects, nervous system effects, reproductive/developmental effects and irritation/burns ([EPA 2020i](#_ENREF_104)). The risk evaluation also identified cancer hazards from carcinogenicity as well as genotoxicity, particularly for liver and lung tumors ([EPA 2020i](#_ENREF_104)).

Among the non-cancer adverse health effects, the *Risk Evaluation for Methylene Chloride* identified neurotoxicity indicative of central nervous system depression as a primary effect of methylene chloride in humans following acute inhalation exposures ([EPA 2020i](#_ENREF_104)). Identified central nervous system depressive symptoms include drowsiness, confusion, headache, dizziness and neurobehavioral deficits when performing various tasks. Central nervous system depressant effects can result in loss of consciousness and respiratory depression, resulting in irreversible coma, hypoxia and eventual death ([EPA 2020i](#_ENREF_104)).

Additionally, the *Risk Evaluation for Methylene Chloride* identified the liver as a sensitive target organ for inhalation exposure ([EPA 2020i](#_ENREF_104)). For human health risks to workers and consumers, EPA identified potential cancer and non-cancer human health risks. Risks from acute exposures include central nervous system risks such as central nervous system depression and a decrease in peripheral vision, each of which can lead to workplace accidents and which are precursors to more severe central nervous system effects such as incapacitation, loss of consciousness, and death. For chronic exposures, EPA identified risks of non-cancer liver effects as well as liver and lung tumors ([EPA 2020i](#_ENREF_104)).

The Risk Evaluation also identified several irritation hazards from methylene chloride exposure. Following exposures to methylene chloride vapors, irritation has been observed in the respiratory tract and eyes. Direct contact with liquid methylene chloride on the skin has caused chemical burns in workers and gastrointestinal irritation in individuals who accidentally ingested methylene chloride ([EPA 2020i](#_ENREF_104)).

## Options Analyzed

To address the unreasonable risk EPA has identified, EPA’s final rule will: prohibit the manufacture, processing, and distribution in commerce of methylene chloride for consumer use; prohibit most industrial and commercial uses of methylene chloride; require a workplace chemical protection program (WCPP), which would include a requirement to meet inhalation exposure concentration limits, for certain continued conditions of use of methylene chloride; require recordkeeping and downstream notification requirements for several conditions of use of methylene chloride; and provide time-limited exemptions as appropriate under TSCA section 6(g).

EPA considered an alternative regulatory option, Option 2, to address the unreasonable risk EPA has identified. This option would prohibit the manufacture, processing, and distribution in commerce of methylene chloride for consumer use; prohibit most industrial and commercial uses of methylene chloride (but would allow a WCPP for Cellulose Triacetate Film Production and prohibit methylene chloride use for the processing aid, plastics manufacturing, and solvent welding use category and the aerospace paint and coatings use category after a 10-year interim WCPP requirement). The alternative option would also require recordkeeping and downstream notification requirements for several conditions of use of methylene chloride; and provide time-limited exemptions under TSCA section 6(g).

Table 1‑2 presents a summary of the options analyzed by use category.

| Table 1‑2: Summary of Options Analyzed by Use Category | | | |
| --- | --- | --- | --- |
| Use Category | Condition of Use (COU) | Option 1 | Option 2 |
| Manufacturing | Manufacturing (Domestic manufacturing) | WCPP | WCPP |
| Import/Repackage | Manufacturing (Import) |
| Processing: repackaging |
| Processing as a Reactant | Processing: processing as a reactant |
| Incorporation Into Formulation, Mixture, or Reaction Product | Processing: incorporation into a formulation, mixture, or reaction product |
| Industrial and commercial use as solvent that becomes part of a formulation or mixture |
| Waste Handling, Disposal, Treatment, and Recycling | Processing: recycling |
| Disposal |
| Laboratory Use | Industrial and commercial use as a laboratory chemical |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Industrial and commercial use as a processing aid | Prohibit |
| Industrial and commercial use as a solvent that becomes part of a formulation or mixture, where that formulation or mixture will be used inside a manufacturing process, and the solvent (methylene chloride) will be reclaimed |
| Industrial and commercial use for plastic and rubber products manufacturing |
| Industrial or commercial use as a bonding agent for solvent welding |
| Aerospace Paint and Coating Removers | Industrial and commercial use as a paint and coating remover from safety critical, corrosion-sensitive components of aircraft and spacecraft | Prohibit with a 10-year time-limited exemption and interim WCPP |
| Cellulose Triacetate Film Production | Industrial and commercial use in cellulose triacetate film production | Prohibit | WCPP |
| Furniture Refinishing | Industrial and commercial use in paint and coating removal in furniture refinishing for intricate or historically significant wood pieces | Prohibit after 5 years with interim worker protection requirements | Prohibit |
| Glues, Sealants, Adhesives, and Caulks | Industrial and commercial use in adhesives and sealants in aircraft, space vehicle, and turbine applications for structural and safety critical non-structural applications | Prohibit after 5 years | Prohibit |
| Industrial and commercial use in adhesives, sealants and caulks (except adhesives and sealants in aircraft, space vehicle, and turbine applications for structural and safety critical non-structural applications) | Prohibit | Prohibit |
| Consumer use in adhesives and sealants |
| Consumer use in arts, crafts, and hobby materials glue |
| Vapor Degreasing | Industrial and commercial use as solvent for batch vapor degreasing |
| Industrial and commercial use as solvent for in-line vapor degreasing |
| Liquid Cleaners and Degreasers | Industrial and commercial use as solvent for cold cleaning |
| Industrial and commercial use in metal non-aerosol degreasers |
| Industrial and commercial use in non-aerosol degreasers and cleaners |
| Aerosol Spray Cleaning/Degreasing | Industrial and commercial use as a solvent for aerosol spray degreaser/cleaner |
| Industrial and commercial use in metal aerosol degreasers |
| Industrial and commercial use in automotive care products (interior car care) |
| Industrial and commercial use in automotive care products (degreasers) |
| Industrial and commercial use in aerosol degreasers and cleaners |
| Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner1 |
| Consumer use as solvent in aerosol degreasers/cleaners |
| Consumer use in metal degreasers |
| Consumer use in automotive care products (degreasers) |
| Consumer use in carbon removers and other brush cleaners1 |
| Paint and Coating Removers (except aerospace and furniture refinishing) | Industrial and commercial use in paint and coating removers (except select wood furniture and safety critical, corrosion-sensitive components of aircraft and spacecraft) |
| Adhesive and Caulk Remover | Industrial and commercial use in adhesive and caulk removers |
| Consumer use in adhesive and caulk removers |
| Lithographic Printing Cleaner | Industrial and commercial use in lithographic printing plate cleaner |
| Dry Cleaning and Spot Removers | Industrial and commercial use in spot removers for apparel and textiles |
| Paint and Coatings | Industrial and commercial use in paints and coatings |
| Lubricants and Greases | Industrial and commercial use in liquid lubricants and greases |
| Industrial and commercial use in spray lubricants and greases |
| Consumer use in lubricants and greases |
| Cold Pipe Insulation | Industrial and commercial use in cold pipe insulations |
| Consumer use in cold pipe insulation |
| Anti-spatter Welding Aerosol | Industrial and commercial use as anti-spatter welding aerosol |
| Consumer use in an anti-spatter welding aerosol |
| Toys, Playground, and Supporting Equipment | Industrial and commercial use in toys, playground and sporting equipment |
| Uses believed to be inactive or fully overlap with other conditions of use | |  |  |
| Wood Floor and Brush Cleaners | Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner1 | Prohibit | Prohibit |
| Consumer use in carbon removers and other brush cleaners1 |
| Consumer use in brush cleaners for paints and coatings2 |
| Functional Fluids | Industrial and commercial use in automotive care products (functional fluids for air conditioners2 |
| Consumer use in automotive care products (functional fluids for air conditioners)2 |
| Propellant and Blowing Agent | Industrial and commercial use as a propellant and blowing agent3 |
| Finishing Products for Fabric, Textiles and Leather | Industrial and commercial use in finishing products for fabric, textiles and leather4 |
| Industrial and commercial use in apparel and footwear care products4 |
| Electrical Equipment, Appliance, and Component Manufacturing | Industrial and commercial use for electrical equipment, appliance, and component manufacturing4 |
| Oil and Gas Drilling | Industrial and commercial use for oil and gas drilling, extraction, and support activities4 |
| 1EPA believes that brush cleaning is an inactive use. Wood floor cleaning is also believed to be an inactive use (although paint removers may be used for this purpose). Carbon removers are an active use and included under aerosol spray cleaning/degreasing. Note that these COUs are listed twice since they include both active and inactive uses.  2Based on market research, EPA believes these are inactive uses.  3Based on stakeholder outreach with industry, EPA believes this is an inactive use.  4These COUs are defined according to the sector using methylene chloride. EPA believes that there are no active uses in these sectors or that the uses by these sectors overlap with one or more of the COUs that are defined according to how the methylene chloride is being used.  Note: Use of methylene chloride by Federal agencies and contractors acting for or on behalf of Federal agencies are subject to a different compliance timeframe not captured in our analyses. | | | |

## Organization of this Document

Chapter 2 presents a discussion of the problems with methylene chloride that are addressed by the rule. Chapter 3 presents general industry statistics for the sectors expected to be affected under the options. Chapter 4 presents information on the products formulated with methylene chloride identified by EPA and the producers of those products. Chapter 5 discusses the availability of alternatives for the different categories of methylene chloride usage and considers the costs and efficacy of the available alternatives. Chapter 6 presents a baseline analysis of the volume of methylene chloride consumption and the numbers of firms, employees, and consumers using methylene chloride. The estimated costs, benefits, and net benefits of the options are presented in Chapter 7, 8, and 9, respectively. Chapter 10 presents various impact analyses. Finally, the references are listed in Chapter 11.

# Problem Definition/Market Failure

This report estimates and evaluates the costs and benefits expected to result from the rule limiting the use of methylene chloride by the U.S. Environmental Protection Agency (EPA) under the authority granted by section 6 of the Toxic Substances Control Act (TSCA). The rule, “Regulation of Methylene Chloride Under TSCA Section 6(a)” addresses the conditions of use presented above in Table 1‑1.

## Methylene Chloride Problem

### Sources of Exposure

Exposure to methylene chloride occurs through the chemical’s conditions of use (COU). TSCA Section 3 defines a chemical’s conditions of use 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.”* EPA’s *Risk Evaluation for Methylene Chloride* evaluated whether exposure resulting from each of methylene chloride’s conditions of use drives unreasonable risk to human and/or environmental health ([EPA 2020i](#_ENREF_104)).

### Health Effects of Methylene Chloride Exposure

Methylene chloride is rapidly absorbed through both oral administration and inhalation exposure with a near steady-state saturation occurring with inhalation. Results from studies of animals show that following absorption, methylene chloride is rapidly distributed throughout the body and has been detected in all tissues that have been evaluated. Effects from acute exposure during use of methylene chloride may include neurological impacts such as dizziness, incapacitation, loss of consciousness, coma, and death. Other effects from chronic exposure may include liver toxicity, kidney toxicity, reproductive toxicity, and cancers such as brain cancer, liver cancer, certain lung cancers, non-Hodgkin’s lymphoma, and multiple myeloma. Methylene chloride is likely to be carcinogenic in humans based on a mutagenic mode of action ([EPA 2011b](#_ENREF_84)).

### Regulatory Approaches for Primary and Alternative Options

Under TSCA section 6(a), if the EPA determines that a chemical substance presents an unreasonable risk of injury to health or the environment, without consideration of costs or other non-risk factors, including an unreasonable risk to a potentially exposed or susceptible subpopulation identified as relevant to the Agency’s risk evaluation, under the conditions of use, EPA must by rule apply one or more requirements to the extent necessary so that the chemical substance no longer presents such risk.

The TSCA section 6(a) requirements can include one or more, or a combination of, the following actions:

* Prohibit or otherwise restrict, or limit the manufacturing, processing, or distribution in commerce of the substance or mixture (TSCA section 6(a)(1)).
* Prohibit or otherwise restrict, or limit the manufacturing, processing, or distribution in commerce of the substance or mixture for particular uses or above a specific concentration for a particular use (TSCA section 6(a)(2)).
* Require clear and adequate minimum warning and instructions with respect to its use, distribution in commerce, or disposal of the substance or mixture (TSCA section 6(a)(3)).
* Require record keeping, monitoring or testing by manufacturers and processors (TSCA 6(a)(4)).
* Prohibit or regulate any manner or method of commercial use of the substance or mixture (TSCA section 6(a)(5)).
* Prohibit or otherwise regulate any manner or method of disposal of the substance or mixture (TSCA section 6(a)(6)).
* Direct manufacturers or processors to give notice of the determination of risk to distributors and users and replace or repurchase the substance or mixture (TSCA section 6(a)(7)).

EPA considered all of the regulatory mechanisms described above, but only a few were determined effective in addressing the identified unreasonable risk of injury to health of methylene chloride under its conditions of use as determined by EPA’s *Risk Evaluation for Methylene Chloride* ([EPA 2020i](#_ENREF_104)). The regulatory mechanisms being utilized as part of this rulemaking to address the identified unreasonable risk include the following:

* **Prohibitions:** The rule considers specific prohibitions on methylene chloride for the use categories indicated in Table 2‑1.
* **Workplace Chemical Protection Program (WCPP):** The rule requires a workplace chemical protection program that includes setting an exposure limit of 2 ppm (8-hr time-weighted average (TWA)) and a short term exposure limit of 16 ppm (15-minute TWA) for the use categories indicated in Table 2‑1 ([EPA 2020c](#_ENREF_98)). Firms would be required to monitor potentially exposed persons to ensure they are not exposed to the chemical at a level that exceeds the exposure limit. The method of reducing exposure to this limit would be left to the firm, but it may include personal protective equipment (PPE) or other engineering controls.

The regulatory actions that EPA chose for methylene chloride under this rulemaking, as well as the primary alternative option, are summarized in Table 2‑1 (see Table 1‑1 for a map between the Use Categories and the COUs). Both EPA’s final rule regulatory option and the alternative option were considered in this Economic Analysis.

| Table 2‑1: Summary of Options by Use Category | | | |
| --- | --- | --- | --- |
| Use Category | Condition of Use (COU) | Option 1 | Option 2 |
| Manufacturing | Manufacturing (Domestic manufacturing) | WCPP | WCPP |
| Import/Repackage | Manufacturing (Import) |
| Processing: repackaging |
| Processing as a Reactant | Processing: processing as a reactant |
| Incorporation Into Formulation, Mixture, or Reaction Product | Processing: incorporation into a formulation, mixture, or reaction product |
| Industrial and commercial use as solvent that becomes part of a formulation or mixture |
| Waste Handling, Disposal, Treatment, and Recycling | Processing: recycling |
| Disposal |
| Laboratory Use | Industrial and commercial use as a laboratory chemical |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Industrial and commercial use as a processing aid | Prohibit |
| Industrial and commercial use as a solvent that becomes part of a formulation or mixture, where that formulation or mixture will be used inside a manufacturing process, and the solvent (methylene chloride) will be reclaimed |
| Industrial and commercial use for plastic and rubber products manufacturing |
| Industrial or commercial use as a bonding agent for solvent welding |
| Aerospace Paint and Coating Removers | Industrial and commercial use as a paint and coating remover from safety critical, corrosion-sensitive components of aircraft and spacecraft | Prohibit with a 10-year time-limited exemption and interim WCPP |
| Cellulose Triacetate Film Production | Industrial and commercial use in cellulose triacetate film production | Prohibit | WCPP |
| Furniture Refinishing | Industrial and commercial use in paint and coating removal in furniture refinishing for intricate or historically significant wood pieces | Prohibit after 5 years with interim worker protection requirements | Prohibit |
| Glues, Sealants, Adhesives, and Caulks | Industrial and commercial use in adhesives and sealants in aircraft, space vehicle, and turbine applications for structural and safety critical non-structural applications | Prohibit after 5 years | Prohibit |
| Industrial and commercial use in adhesives, sealants and caulks (except adhesives and sealants in aircraft, space vehicle, and turbine applications for structural and safety critical non-structural applications) | Prohibit | Prohibit |
| Consumer use in adhesives and sealants |
| Consumer use in arts, crafts, and hobby materials glue |
| Vapor Degreasing | Industrial and commercial use as solvent for batch vapor degreasing |
| Industrial and commercial use as solvent for in-line vapor degreasing |
| Liquid Cleaners and Degreasers | Industrial and commercial use as solvent for cold cleaning |
| Industrial and commercial use in metal non-aerosol degreasers |
| Industrial and commercial use in non-aerosol degreasers and cleaners |
| Aerosol Spray Cleaning/Degreasing | Industrial and commercial use as a solvent for aerosol spray degreaser/cleaner |
| Industrial and commercial use in metal aerosol degreasers |
| Industrial and commercial use in automotive care products (interior car care) |
| Industrial and commercial use in automotive care products (degreasers) |
| Industrial and commercial use in aerosol degreasers and cleaners |
| Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner1 |
| Consumer use as solvent in aerosol degreasers/cleaners |
| Consumer use in metal degreasers |
| Consumer use in automotive care products (degreasers) |
| Consumer use in carbon removers and other brush cleaners1 |
| Paint and Coating Removers (except aerospace and furniture refinishing) | Industrial and commercial use in paint and coating removers (except select wood furniture and safety critical, corrosion-sensitive components of aircraft and spacecraft) |
| Adhesive and Caulk Remover | Industrial and commercial use in adhesive and caulk removers |
| Consumer use in adhesive and caulk removers |
| Lithographic Printing Cleaner | Industrial and commercial use in lithographic printing plate cleaner |
| Dry Cleaning and Spot Removers | Industrial and commercial use in spot removers for apparel and textiles |
| Paint and Coatings | Industrial and commercial use in paints and coatings |
| Lubricants and Greases | Industrial and commercial use in liquid lubricants and greases |
| Industrial and commercial use in spray lubricants and greases |
| Consumer use in lubricants and greases |
| Cold Pipe Insulation | Industrial and commercial use in cold pipe insulations |
| Consumer use in cold pipe insulation |
| Anti-spatter Welding Aerosol | Industrial and commercial use as anti-spatter welding aerosol |
| Consumer use in an anti-spatter welding aerosol |
| Toys, Playground, and Supporting Equipment | Industrial and commercial use in toys, playground and sporting equipment |
| Uses believed to be inactive or fully overlap with other conditions of use | |  |  |
| Wood Floor and Brush Cleaners | Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner1 | Prohibit | Prohibit |
| Consumer use in carbon removers and other brush cleaners1 |
| Consumer use in brush cleaners for paints and coatings2 |
| Functional Fluids | Industrial and commercial use in automotive care products (functional fluids for air conditioners2 |
| Consumer use in automotive care products (functional fluids for air conditioners)2 |
| Propellant and Blowing Agent | Industrial and commercial use as a propellant and blowing agent3 |
| Finishing Products for Fabric, Textiles and Leather | Industrial and commercial use in finishing products for fabric, textiles and leather4 |
| Industrial and commercial use in apparel and footwear care products4 |
| Electrical Equipment, Appliance, and Component Manufacturing | Industrial and commercial use for electrical equipment, appliance, and component manufacturing4 |
| Oil and Gas Drilling | Industrial and commercial use for oil and gas drilling, extraction, and support activities4 |
| 1EPA believes that brush cleaning is an inactive use. Wood floor cleaning is also believed to be an inactive use (although paint removers may be used for this purpose). Carbon removers are an active use and included under aerosol spray cleaning/degreasing. Note that these COUs are listed twice since they include both active and inactive uses.  2Based on market research, EPA believes these are inactive uses.  3Based on stakeholder outreach with industry, EPA believes this is an inactive use.  4These COUs are defined according to the sector using methylene chloride. EPA believes that there are no active uses in these sectors or that the uses by these sectors overlap with one or more of the COUs that are defined according to how the methylene chloride is being used. | | | |

## Regulatory Background

Because of its potential health effects, methylene chloride is subject to numerous state, federal, and international regulations restricting and regulating its use. The following is a summary of the regulatory actions pertaining to methylene chloride; for a full description see Appendix A of the *Risk Evaluation for Methylene Chloride* ([EPA 2020i](#_ENREF_104)).

### EPA actions pertaining to methylene chloride

EPA has issued numerous rules and notices pertaining to methylene chloride under its various authorities. Methylene chloride is regulated as a chemical substance under TSCA. In August 2014, the agency published a TSCA Work Plan Chemical Risk Assessment addressing for the paint stripping and coating removal use of methylene chloride ([EPA 2014b](#_ENREF_87)). Based on this pre-Lautenberg risk assessment, EPA finalized a rule under TSCA to address unreasonable risk to consumers from methylene chloride in paint and coating removal in 2019 (84 FR 11420, March 27, 2019). The regulation prohibits the manufacture (including import), processing, and distribution in commerce of methylene chloride for consumer paint and coating removal, including distribution to and by retailers; requires manufacturers (including importers), processors, and distributors, except for retailers, of methylene chloride for any use to provide downstream notification of these prohibitions; and requires recordkeeping. Note industrial and commercial use as a paint and coating remover is covered by this rulemaking. Methylene chloride manufacturing (including importing), processing, and use information is also reported under the Chemical Data Reporting (CDR) rule (85 FR 20122, April 9, 2020).

Methylene chloride is also a listed substance on the Toxics Release Inventory (TRI) pursuant to Section 313 of the Emergency Planning and Community Right-to-Know Act. Methylene chloride is listed under 40 CFR 372.65 as a chemical subject to the TRI reporting requirements, effective as of January 1, 1987.

In pesticides, methylene chloride was registered as an antimicrobial conventional chemical in 1974 pursuant to the Federal Food, Drug, and Cosmetic Act (FFDCA). In 1998, EPA removed methylene chloride from its list of pesticide product inert ingredients that are currently used in pesticide products (63 FR 34385, June 24, 1998). The tolerance exemptions for methylene chloride were revoked in 2002 (67 FR 16027, April 4, 2002).

Relative to releases to air, methylene chloride has been designated a hazardous air pollutant (HAP) under the Clean Air Act (CAA) (42 U.S.C. 7412(b)(1)) and is considered an “urban air toxic” (CAA Section 112(k)). Under the Significant New Alternatives Policy (SNAP) program, EPA listed methylene chloride as an acceptable substitute in multiple industrial end-uses, including as a blowing agent in polyurethane foam, in cleaning solvents, in aerosol solvents and in adhesives and coatings (59 FR 13044, March 18, 1994). In 2016, methylene chloride was listed as an unacceptable substitute for use as a blowing agent in the production of flexible polyurethane foam (81 FR 86778, December 1, 2016). Under the CAA Section 112(d), EPA has established national emission standards for hazardous air pollutants (NESHAPs) for a number of source categories that emit methylene chloride. Applicable NESHAPs include: 40 CFR part 63 subpart F, Synthetic Organic Chemical Manufacturing Industry; 40 CFR part 63 subpart DD, Off-Site Waste and Recovery Operations; 40 CFR part 63 subpart VVV, Publicly Owned Treatment Works; regulates methylene chloride 40 CFR part 63 subpart VVVVVV, the NESHAP for Chemical Manufacturing Area Sources. Under the CAA Section 112(f), EPA has promulgated a number of Risk and Technology Review (RTR) NESHAP (such as the RTR NESHAP for Halogenated Solvent Cleaning (72 FR 25138, May 3, 2007)) and will do so, as required, for the remaining source categories with NESHAP.

Relative to releases to water, methylene chloride is designated as a toxic pollutant under Section 307(a)(1) of the Clean Water Act (CWA) and as such is subject to effluent limitations. Under CWA Section 304, methylene chloride is included in the list of total toxic organics (TTO) (40 CFR 413.02(i)). Methylene chloride is subject to National Primary Drinking Water Regulation (NPDWR) under the Safe Drinking Water Act (SDWA) with a non-enforceable maximum contaminant level goal (MCLG) of zero and an enforceable maximum contaminant level (MCL) of 0.005 mg/L or 5 ppb (40 CFR part 151).

In terms of environmental release notification, methylene chloride is a hazardous substance under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Releases of methylene chloride in excess of 1,000 pounds must be reported under CERCLA (40 CFR 302.4). Relative to disposal, methylene chloride is listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) (RCRA Hazardous Waste Codes U080, F001, F002) (40 CFR 261.31, 261.32). In 2013, EPA modified its hazardous waste management regulations to conditionally exclude solvent-contaminated wipes that have been cleaned and reused from the definition of solid waste under RCRA and to conditionally exclude solvent-contaminated wipes that are disposed from the definition of hazardous waste (78 FR 46448, July 31, 2013).

### Other Federal Regulations

In addition to regulations administered by the EPA, methylene chloride is also subject to regulations by other federal agencies, described in this section.

In 1987, CPSC issued a decision to require labeling of products that contain methylene chloride under the Federal Hazardous Substances Act (FHSA) (52 FR 34698, September 14, 1987). Labels indicated that inhalation of methylene chloride vapor has caused cancer in certain laboratory animals, and the labels specified precautions to be taken during use by consumers. In 2016, the Halogenated Solvents Industry Alliance (HSIA) petitioned the CPSC to amend the CPSC’s labeling interpretation and policy on those products (81 FR 60298, September 1, 2016). In 2018, CPSC updated the labeling policy for paint strippers containing methylene chloride to include a warning of the acute hazards from inhalation of methylene chloride vapors in addition to the chronic hazards (83 FR 12254, March 21, 2018 and 83 FR 18219, April 26, 2018).

In 2005, the Secretary of Transportation listed methylene chloride as a hazardous material with regard to transportation that is subject to regulations prescribing requirements applicable to the shipment and transportation of listed hazardous materials under the Hazardous Materials Transportation Act (70 FR 34381, June 14, 2005).

In 1989, the FDA banned methylene chloride as an ingredient in all cosmetic products because of its animal carcinogenicity and likely hazard to human health under the Federal Food, Drug, and Cosmetic Act (FFDCA) (54 FR 27328, June 29, 1989). Before 1989, methylene chloride had been used in aerosol cosmetic products, such as hairspray ([EPA 2020i](#_ENREF_104)).

In 1997, OSHA revised existing occupational safety and health standards for methylene chloride, to include an 8-hr time weighted average (TWA) permissible exposure limit (PEL) of 25 ppm and a 15-minute short term exposure limit (STEL) of 125 ppm, exposure monitoring, control measures and respiratory protection (29 CFR 1910.1052 App. A).

Additionally, the National Institute for Occupational Safety and Health (NIOSH) considers methylene chloride a potential occupational carcinogen. NIOSH also in 2013 issued a hazard alert for fatal hazards related to methylene chloride use in bathtub refinishing ([OSHA and NIOSH 2013](#_ENREF_42)).

### State Regulations

Many states have taken actions to reduce risks from methylene chloride, such as setting detection monitoring regulations and listing methylene chloride as a hazardous substance. Many states regulate methylene chloride as a volatile organic compound (VOC) by setting VOC limits for consumer products or banning the sale of certain consumer products that have methylene chloride as an ingredient or impurity. Many states have set state drinking water standards and guidelines for methylene chloride.

For example, Massachusetts designated methylene chloride as a higher hazard substance (301 CMR 41.00), which required reporting starting in 2014. Several states have adopted reporting laws for chemicals in children’s products that include methylene chloride, including Maine (38 MRSA Chapter 16-D), Minnesota (Minnesota Statutes 116.9401 to 116.9407), Oregon (Toxic-Free Kids Act, Senate Bill 478, 2015), Vermont (18 V.S.A. section 1776), and Washington State (WAC 173-334-130).

California has a permissible exposure limit (PEL) of 25 ppm as an 8-hr-time-weighted average (TWA) and a short-term exposure limit (STEL) of 100 ppm (Cal Code Regs. title 8, section 5155). California listed methylene chloride on the Proposition 65 list (Cal Code Regs. title 27, section 27001) and listed paint or varnish strippers containing methylene chloride as a priority product.[[4]](#footnote-6)

### International Regulations

Countries other than the United States also regulate the use of methylene chloride ([EPA 2020i](#_ENREF_104)). In 2010, the European Union added the restriction of sale and use of paint removers containing 0.1% or more methylene chloride to Annex XVII of regulation (EC) No 1907/2002 – REACH (Registration, Evaluation, Authorization and Restriction of Chemicals), which included provisions for individual member states to issue derogation for professional uses if they have completed proper training and demonstrate they are capable of safely using paint removers containing methylene chloride ([ECHA 2017](#_ENREF_18)).

Several countries have set occupational exposure limits (OELs) for methylene chloride, including Australia, Belgium, Finland, South Korea, and Spain ([German Social Accident Insurance 2017](#_ENREF_20)).

## Justification for Risk Management Action for Methylene Chloride

This section provides legal and economic justification of the rule to regulate methylene chloride in the United States at the federal level of government. Section 2.3.1 indicates the statutory authority for EPA to take risk management action, Section 2.3.2 identifies market failure in the industries where methylene chloride is used, Section 2.3.3 discusses regulatory remedies to address market failure from negative externalities, and Section 2.3.4 provides justification for regulation at the federal level specifically.

### Statutory Authority

The Frank R. Lautenberg Chemical Safety for the 21st Century Act amended the Toxic Substances Control Act (TSCA), the nation’s primary chemicals management law, in June 2016. Under the amended statute, EPA is required, under TSCA Section 6(b), to conduct risk evaluations to determine whether a chemical substance presents an unreasonable risk of injury to health or the environment, under the conditions of use, without consideration of costs or other non-risk factors, including an unreasonable risk to potentially exposed or susceptible subpopulations identified as relevant to the Risk Evaluation. If unreasonable risk is found, EPA is required to address the risk so that it is no longer unreasonable through a Risk Management regulation.

### Market Failure

The private market is a mechanism that can allocate resources efficiently. However, the market’s allocation of resources will not always be desirable from the standpoint of society. The market will fail to achieve a socially efficient outcome when differences exist between private market values and social values.

Welfare economics states that a socially efficient outcome is achieved if no alternative allocation of society’s resources can make at least one person better off without making another one worse off. This is referred to as a Pareto optimal outcome. If the private market fails to achieve this efficient outcome, too little or too much is produced, resulting in a loss in economic welfare. This is referred to as a market failure.

However, Pareto optimality is a strict condition and can allow for very unequal allocations. It does not address redistributive actions, in which one group is made worse off and another group is made better off. A less strict criteria for measuring economic improvement is Kaldor-Hicks efficiency. Under this criterion, economic efficiency is improved if those who benefit from an action gain more than those who lose from that action.[[5]](#footnote-7) This is the fundamental efficiency criterion of benefit-cost analysis: society is considered to be better off (in terms of economic efficiency) if the benefits of an action outweigh the cost of undertaking it.

Government regulation of a private market is justified when the market fails to deliver a socially efficient outcome. If a regulation can produce benefits that exceeds its cost, then economic efficiency has been improved. The economic literature has identified the following common causes of market failure and economic inefficiency:

* Existence of externalities (negative and positive);
* Under-provision of common property resources, and public goods;
* Market power (e.g., monopolies);
* Inadequate or asymmetric information

This section discusses how negative externalities are present in the market for the chemical regulated under this rule[[6]](#footnote-8). By understanding how the market is affected by this market failure, more effective regulations can be designed.

#### Externalities

A negative externality occurs when one party’s action imposes an uncompensated negative effect on another party. For example, the manufacturer, processor, or consumer of a good may impose costs on another party if the good causes an adverse health impact that is not known or factored into the market transaction. Since these external costs are not internalized by the manufacturer, processor, or user, they are not considered in the production (or processing, use) and pricing decisions. As a result, the societal cost of these goods is under-valued and the level of output produced (or processed, used) is higher than the social optimal output level. In other words, a negative externality occurs when a firm makes decisions based on private costs instead of social costs, leading to an excess of product in the market.

EPA believes that the cause of market failure in the market for methylene chloride subject to this rule stems from negative externalities. While many of the adverse health effects from exposure to methylene chloride are well established (EPA [2020i](#_ENREF_104)), these adverse health effects are not internalized by those manufacturing, processing, distributing, or using the chemical and too much methylene chloride is traded in the market. If the cost of these health effects were internalized, the price of methylene chloride would be higher and less would be traded in the market. While it is theoretically possible force manufactures, processers, distributers, and users to internalize the external costs of methylene chloride (for example, thorough a pollution tax or tradable permit program), EPA believes that this is not the right approach for addressing the negative externality in this market. This approach would be administratively burdensome and impose high transaction costs in a market with a multitude and varied conditions of use. Instead, EPA’s approach is to decrease the volume of methylene chloride in the market closer to what would be socially optimal and, thereby, reduce the negative externality of health impacts caused by exposure to the chemical.

Society will experience health benefits from regulatory measures that limit or eliminate the manufacture, processing and use of methylene chloride. However, society will experience *net benefits* from these regulatory measures only up to the point where the benefits of reducing these negative externalities are less than the costs of achieving them. If the costs of these regulatory measures on manufacturers and users of methylene chloride are greater than the external costs imposed by their use, the regulation is too strict and the new state is also suboptimal. Social welfare would be decreased by any regulatory measure that goes beyond the point where the volume of methylene chloride has been reduced to the same point as if the externalities were internalized. The economically efficient level of control is where the additional (marginal) cost of further control equals society’s willingness to pay for the next increment of control. Adverse effects may still occur at this level, but additional regulatory costs to further reduce or eliminate these effects would not be Pareto optimal. Conversely, if post-rule, the cost to society from release and exposure to methylene chloride remains greater than costs to regulated firms, the rule would also not produce a Pareto optimal outcome.

### Regulatory Remedies to Reduce Negative Externalities

As discussed in Section 2.1.3, the final rule regulatory option and alternative options detail various requirements that will reduce the negative human health costs associated with the negative externality. Prohibition of the chemical, direct dermal contact controls (DDCC), Existing Chemical Exposure Limit (ECEL), and Monitoring and Hierarchy of Controls (HOC) requirements all reduce exposure of methylene chloride to third parties. EPA contends that these measures are sufficient to reduce negative externalities associated with methylene chloride.

### Justification for Regulation at Federal Level

The chemical and products associated with this rulemaking are distributed in commerce across state lines, and thus they fall under the federal jurisdiction of regulation under TSCA. It is more efficient for companies manufacturing, processing, distributing, using and disposing of these products to comply with a single federal standard rather than a patchwork of different state regulations.

# Profile of Affected Industries

Table 3‑1 shows the industry statistics for each NAICS code ([U.S. Census Bureau 2021](#_ENREF_79); [U.S. Census Bureau 2022](#_ENREF_80); [BEA 2023](#_ENREF_71)), indicates which use categories are applicable for each NAICS, and presents the estimated numbers of firms and employment for firms defined as small businesses according to the SBA definitions ([Dun & Bradstreet 2022](#_ENREF_17); [SBA 2023](#_ENREF_111)).

NAICS codes were identified for the use categories as follows:

* Manufacturing, Import/Repackage, and Processing as a reactant were identified using 2020 CDR data ([EPA 2022a](#_ENREF_107)).
* Incorporation Into Formulation, Mixture, or Reaction Product NAICS were identified using the [Experian (2023)](#_ENREF_19) or the Dun and Bradstreet Hoovers database ([Dun & Bradstreet 2022](#_ENREF_17)) to look up the parent companies of the formulators of the methylene chloride products listed in Chapter 4.
* Processing Aid, Plastics Manufacturing, and Solvent Welding NAICS were identified using the [Experian (2023)](#_ENREF_19) database to look up the parent companies of firms that submitted comments on the proposed rule that identified themselves as firms in this use category.
* Cellulose Triacetate Film Production, batch, liquid, and spray cold cleaning, paint and coatings, and vapor degreasing were identified using 2017 NEI data ([EPA 2020a](#_ENREF_96)).
* The 4-digit NAICS for remaining use categories were identified using OSHA inspection ([OSHA 2020a](#_ENREF_51)) and enforcement data ([OSHA 2016c](#_ENREF_50)), where available, and EPA best judgement for selecting the corresponding 6-digit NAICS and where OSHA data were not available

| Table 3‑1: Industry Statistics | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Use Categories | NAICS | Small Business Threshold | Number of Firms | | Number of Establish-ments | Employment | | Annual Payroll (thousands, 2022$) | Preliminary Receipts (thousands, 2022$) |
| All | SBA-Defined Small | All | SBA-Defined Small |
| Manufacturing | 211120: Crude Petroleum Extraction | 1,250 employees | 4,570 | 4,524 | 5,333 | 85,169 | 53,015 | $11,946,357 | $177,161,463 |
| Paint and Coating Removers (Professional Contracting) | 236115: New Single-Family Housing Construction (except For-Sale Builders) | $45m revenue | 49,215 | 49,072 | 49,387 | 170,836 | 157,255 | $11,291,468 | $74,078,537 |
| Paint and Coating Removers (Professional Contracting) | 236116: New Multifamily Housing Construction (except For-Sale Builders) | $45m revenue | 3,175 | 2,881 | 3,250 | 45,295 | 20,044 | $4,365,079 | $53,305,035 |
| Furniture Refinishing; Paint and Coating Removers (Bathtub Refinishing); Paint and Coating Removers (Professional Contracting) | 236118: Residential Remodelers | $45m revenue | 103,079 | 102,928 | 103,504 | 343,089 | 322,529 | $19,020,041 | $86,684,054 |
| Paint and Coating Removers (Professional Contracting) | 236210: Industrial Building Construction | $45m revenue | 2,997 | 2,849 | 3,183 | 68,366 | 30,502 | $5,859,218 | $28,197,947 |
| Furniture Refinishing; Paint and Coating Removers (Professional Contracting) | 236220: Commercial and Institutional Building Construction | $45m revenue | 38,079 | 36,219 | 39,289 | 578,967 | 314,915 | $53,153,644 | $473,514,202 |
| Paint and Coating Removers (Professional Contracting) | 237310: Highway, Street, and Bridge Construction | $45m revenue | 8,826 | 8,132 | 9,673 | 290,882 | 120,482 | $26,937,580 | $137,429,555 |
| Paint and Coating Removers (Professional Contracting) | 238110: Poured Concrete Foundation and Structure Contractors | $19m revenue | 20,615 | 20,039 | 20,771 | 235,367 | 142,194 | $15,242,315 | $58,008,169 |
| Furniture Refinishing; Paint and Coating Removers (Professional Contracting) | 238130: Framing Contractors | $19m revenue | 11,524 | 11,348 | 11,547 | 83,345 | 57,717 | $4,327,056 | $17,796,796 |
| Paint and Coating Removers (Professional Contracting) | 238140: Masonry Contractors | $19m revenue | 18,274 | 18,033 | 18,391 | 139,879 | 104,924 | $7,960,333 | $25,989,899 |
| Paint and Coating Removers (Professional Contracting) | 238160: Roofing Contractors | $19m revenue | 19,132 | 18,716 | 19,396 | 173,440 | 123,468 | $11,457,292 | $44,842,710 |
| Paint and Coating Removers (Professional Contracting); Lubricants and Greases | 238220: Plumbing, Heating, and Air-Conditioning Contractors | $19m revenue | 100,692 | 98,716 | 102,455 | 1,015,585 | 659,110 | $72,382,963 | $226,690,605 |
| Cold Pipe Insulation | 238290: Other Building Equipment Contractors | $22m revenue | 6,257 | 5,993 | 7,377 | 131,539 | 60,053 | $12,064,364 | $35,721,283 |
| Paint and Coating Removers (Professional Contracting) | 238310: Drywall and Insulation Contractors | $19m revenue | 17,780 | 17,278 | 18,334 | 254,754 | 137,576 | $16,079,172 | $49,237,020 |
| Aerospace Paint and Coating Removers; Furniture Refinishing; Paint and Coating Removers (Professional Contracting) | 238320: Painting and Wall Covering Contractors | $19m revenue | 35,459 | 35,290 | 35,535 | 187,185 | 159,647 | $9,890,917 | $27,861,569 |
| Furniture Refinishing; Paint and Coating Removers (Professional Contracting) | 238330: Flooring Contractors | $19m revenue | 15,813 | 15,631 | 16,029 | 77,401 | 60,381 | $4,540,299 | $19,868,168 |
| Paint and Coating Removers (Bathtub Refinishing) | 238340: Tile and Terrazzo Contractors | $19m revenue | 9,790 | 9,722 | 9,812 | 56,879 | 49,953 | $3,110,265 | $10,161,877 |
| Furniture Refinishing; Paint and Coating Removers (Professional Contracting) | 238350: Finish Carpentry Contractors | $19m revenue | 29,615 | 29,373 | 29,840 | 145,723 | 121,939 | $8,214,007 | $30,188,711 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding; Paint and Coating Removers (Bathtub Refinishing) | 238390: Other Building Finishing Contractors | $19m revenue | 6,696 | 6,564 | 6,799 | 69,658 | 52,493 | $4,218,246 | $11,800,149 |
| Vapor Degreasing; | 238910: Site Preparation Contractors | $19m revenue | 35,323 | 34,030 | 35,718 | 379,707 | 235,180 | $27,979,797 | $109,639,284 |
| Furniture Refinishing; Paint and Coating Removers (Bathtub Refinishing); Paint and Coating Removers (Professional Contracting) | 238990: All Other Specialty Trade Contractors | $19m revenue | 33,526 | 33,089 | 33,943 | 245,033 | 175,168 | $16,101,568 | $58,754,082 |
| Liquid Cleaners and Degreasers | 311812: Commercial Bakeries | 1,000 employees | 2,750 | 2,683 | 3,031 | 126,666 | 69,376 | $5,890,214 | $35,440,957 |
| Liquid Cleaners and Degreasers | 312230: Tobacco Manufacturing | 1,500 employees | 136 | 130 | 159 | 13,850 | 5,473 | $952,559 | $52,626,778 |
| Liquid Cleaners and Degreasers | 314999: All Other Miscellaneous Textile Product Mills | 550 employees | 2,463 | 2,442 | 2,511 | 30,484 | 24,393 | $1,198,641 | $4,886,369 |
| Liquid Cleaners and Degreasers | 321113: Sawmills | 550 employees | 2,532 | 2,478 | 2,873 | 76,755 | 49,096 | $4,068,945 | $28,290,517 |
| Furniture Refinishing | 321918: Other Millwork (including Flooring) | 500 employees | 1,460 | 1,423 | 1,557 | 33,243 | 22,115 | $1,408,328 | $7,938,668 |
| Paint and Coatings | 321991: Manufactured Home (Mobile Home) Manufacturing | 1,250 employees | 158 | 150 | 238 | 22,114 | 7,029 | $1,100,661 | $5,012,984 |
| Paint and Coatings | 321992: Prefabricated Wood Building Manufacturing | 500 employees | 543 | 524 | 635 | 17,299 | 9,686 | $1,033,832 | $4,367,458 |
| Furniture Refinishing | 321999: All Other Miscellaneous Wood Product Manufacturing | 500 employees | 2,624 | 2,587 | 2,742 | 31,090 | 23,371 | $1,543,127 | $7,074,699 |
| Liquid Cleaners and Degreasers | 322121: Paper (except Newsprint) Mills | 1,250 employees | 101 | 82 | 193 | 57,140 | 13,484 | $4,033,052 | $46,627,296 |
| Glues, Sealants, Adhesives, and Caulks; Adhesive and Caulk Remover | 322130: Paperboard Mills | 1,250 employees | 75 | 48 | 166 | 34,117 | 3,851 | $3,499,766 | $33,754,469 |
| Glues, Sealants, Adhesives, and Caulks; Adhesive and Caulk Remover | 322211: Corrugated and Solid Fiber Box Manufacturing | 1,250 employees | 648 | 619 | 1,231 | 87,342 | 36,944 | $5,150,284 | $48,657,768 |
| Paint and Coatings | 322220: Paper Bag and Coated and Treated Paper Manufacturing | 750 employees | 575 | 509 | 740 | 48,193 | 20,732 | $3,384,886 | $22,701,713 |
| Cellulose Triacetate Film Production; Lithographic Printing Cleaner | 323111: Commercial Printing (except Screen and Books) | 650 employees | 16,968 | 16,805 | 18,194 | 333,132 | 217,700 | $17,155,203 | $73,511,160 |
| Paint and Coatings | 323113: Commercial Screen Printing | 500 employees | 5,156 | 5,128 | 5,187 | 64,671 | 53,488 | $2,470,804 | $9,245,207 |
| Lubricants and Greases | 324191: Petroleum Lubricating Oil and Grease Manufacturing | 900 employees | 253 | 219 | 318 | 12,462 | 6,788 | $1,136,613 | $17,462,749 |
| Incorporation Into Formulation, Mixture, or Reaction Product; Processing Aid, Plastics Manufacturing, and Solvent Welding | 325180: Other Basic Inorganic Chemical Manufacturing | 1,000 employees | 363 | 302 | 626 | 39,878 | 16,307 | $3,941,903 | $35,119,713 |
| Manufacturing; Processing as a reactant; Paint and Coatings | 325199: All Other Basic Organic Chemical Manufacturing | 1,250 employees | 591 | 511 | 814 | 67,603 | 24,105 | $7,183,531 | $84,240,606 |
| Processing as a reactant; Processing Aid, Plastics Manufacturing, and Solvent Welding; | 325211: Plastics Material and Resin Manufacturing | 1,250 employees | 852 | 768 | 1,125 | 75,998 | 34,018 | $7,265,774 | $98,346,670 |
| Liquid Cleaners and Degreasers | 325220: Artificial and Synthetic Fibers and Filaments Manufacturing | 1,050 employees | 109 | 87 | 132 | 14,220 | 5,717 | $892,614 | $7,720,048 |
| Incorporation Into Formulation, Mixture, or Reaction Product | 325320: Pesticide and Other Agricultural Chemical Manufacturing | 1,150 employees | 188 | 170 | 229 | 10,798 | 5,181 | $936,297 | $16,505,466 |
| Incorporation Into Formulation, Mixture, or Reaction Product; Paint and Coatings | 325510: Paint and Coating Manufacturing | 1,000 employees | 998 | 964 | 1,197 | 39,139 | 22,907 | $2,659,105 | $30,152,364 |
| Incorporation Into Formulation, Mixture, or Reaction Product; Paint and Coatings | 325520: Adhesive Manufacturing | 550 employees | 403 | 346 | 559 | 24,231 | 9,109 | $1,904,133 | $16,251,270 |
| Incorporation Into Formulation, Mixture, or Reaction Product | 325611: Soap and Other Detergent Manufacturing | 1,100 employees | 618 | 594 | 675 | 25,387 | 11,428 | $1,825,467 | $26,806,463 |
| Incorporation Into Formulation, Mixture, or Reaction Product; Paint and Coating Removers (Professional Contracting) | 325612: Polish and Other Sanitation Good Manufacturing | 900 employees | 419 | 396 | 458 | 15,779 | 10,287 | $1,016,000 | $6,847,712 |
| Paint and Coatings | 325991: Custom Compounding of Purchased Resins | 600 employees | 330 | 292 | 402 | 19,529 | 9,604 | $1,365,589 | $12,566,182 |
| Liquid Cleaners and Degreasers; Paint and Coatings | 325992: Photographic Film, Paper, Plate, and Chemical Manufacturing | 1,500 employees | 189 | 175 | 204 | 8,712 | 2,547 | $446,914 | $7,329,679 |
| Import/Repackage; Incorporation Into Formulation, Mixture, or Reaction Product; Processing Aid, Plastics Manufacturing, and Solvent Welding; Glues, Sealants, Adhesives, and Caulks; Liquid Cleaners and Degreasers; Adhesive and Caulk Remover; Paint and Coatings | 325998: All Other Miscellaneous Chemical Product and Preparation Manufacturing | 650 employees | 1,064 | 982 | 1,230 | 36,900 | 17,820 | $2,999,789 | $24,005,697 |
| Glues, Sealants, Adhesives, and Caulks; Liquid Cleaners and Degreasers; Adhesive and Caulk Remover | 326121: Unlaminated Plastics Profile Shape Manufacturing | 600 employees | 326 | 290 | 375 | 20,033 | 9,886 | $1,209,452 | $8,858,350 |
| Paint and Coatings | 326130: Laminated Plastics Plate, Sheet (except Packaging), and Shape Manufacturing | 650 employees | 208 | 182 | 230 | 12,378 | 6,419 | $835,176 | $4,808,508 |
| Glues, Sealants, Adhesives, and Caulks; Adhesive and Caulk Remover | 326160: Plastics Bottle Manufacturing | 1,250 employees | 195 | 181 | 470 | 31,243 | 10,574 | $1,789,469 | $12,344,511 |
| Liquid Cleaners and Degreasers | 326191: Plastics Plumbing Fixture Manufacturing | 750 employees | 311 | 301 | 346 | 17,300 | 11,551 | $863,166 | $4,639,729 |
| Vapor Degreasing; Liquid Cleaners and Degreasers; Paint and Coatings | 326199: All Other Plastics Product Manufacturing | 750 employees | 5,187 | 4,888 | 6,156 | 374,862 | 190,204 | $19,256,734 | $104,365,866 |
| Glues, Sealants, Adhesives, and Caulks; Aerosol Spray Cleaning/Degreasing; Adhesive and Caulk Remover; Paint and Coatings | 326211: Tire Manufacturing (except Retreading) | 1,500 employees | 81 | 63 | 114 | 45,509 | 2,569 | $3,329,563 | $19,979,541 |
| Aerosol Spray Cleaning/Degreasing; | 326212: Tire Retreading | 500 employees | 261 | 241 | 373 | 6,568 | 3,379 | $311,249 | $1,616,014 |
| Paint and Coatings | 326220: Rubber and Plastics Hoses and Belting Manufacturing | 800 employees | 196 | 177 | 273 | 19,713 | 8,697 | $1,122,921 | $5,825,212 |
| Liquid Cleaners and Degreasers; Paint and Coatings | 326299: All Other Rubber Product Manufacturing | 650 employees | 565 | 508 | 666 | 29,771 | 15,816 | $1,907,310 | $11,123,715 |
| Liquid Cleaners and Degreasers | 327331: Concrete Block and Brick Manufacturing | 500 employees | 430 | 400 | 686 | 16,575 | 10,253 | $877,470 | $5,140,280 |
| Paint and Coatings | 331110: Iron and Steel Mills and Ferroalloy Manufacturing | 1,500 employees | 369 | 325 | 522 | 93,552 | 17,946 | $8,399,242 | $100,863,709 |
| Liquid Cleaners and Degreasers; Paint and Coatings | 331210: Iron and Steel Pipe and Tube Manufacturing from Purchased Steel | 1,000 employees | 180 | 144 | 241 | 23,495 | 11,670 | $1,880,672 | $11,546,203 |
| Liquid Cleaners and Degreasers | 331410: Nonferrous Metal (except Aluminum) Smelting and Refining | 1,000 employees | 129 | 113 | 146 | 7,908 | 3,738 | $631,356 | $10,981,057 |
| Liquid Cleaners and Degreasers | 331420: Copper Rolling, Drawing, Extruding, and Alloying | 1,050 employees | 164 | 138 | 247 | 24,375 | 10,955 | $1,573,829 | $24,451,691 |
| Vapor Degreasing | 331491: Nonferrous Metal (except Copper and Aluminum) Rolling, Drawing, and Extruding | 900 employees | 227 | 202 | 255 | 15,488 | 4,606 | $1,234,599 | $7,349,300 |
| Liquid Cleaners and Degreasers | 331512: Steel Investment Foundries | 1,050 employees | 95 | 87 | 114 | 12,986 | 6,542 | $954,447 | $3,975,656 |
| Liquid Cleaners and Degreasers | 332111: Iron and Steel Forging | 750 employees | 324 | 295 | 376 | 19,681 | 9,072 | $1,395,388 | $8,430,566 |
| Liquid Cleaners and Degreasers | 332112: Nonferrous Forging | 950 employees | 50 | 39 | 60 | 6,753 | 1,717 | $522,959 | $3,188,726 |
| Liquid Cleaners and Degreasers | 332117: Powder Metallurgy Part Manufacturing | 550 employees | 114 | 104 | 134 | 9,416 | 5,313 | $525,010 | $2,565,953 |
| Vapor Degreasing; Liquid Cleaners and Degreasers | 332119: Metal Crown, Closure, and Other Metal Stamping (except Automotive) | 500 employees | 1,288 | 1,231 | 1,385 | 51,465 | 38,579 | $2,783,562 | $12,694,974 |
| Glues, Sealants, Adhesives, and Caulks; Liquid Cleaners and Degreasers; Adhesive and Caulk Remover | 332215: Metal Kitchen Cookware, Utensil, Cutlery, and Flatware (except Precious) Manufacturing | 1,000 employees | 207 | 195 | 213 | 7,430 | 3,892 | $423,145 | $3,568,719 |
| Liquid Cleaners and Degreasers | 332216: Saw Blade and Handtool Manufacturing | 750 employees | 864 | 845 | 930 | 26,889 | 18,722 | $1,599,261 | $6,940,093 |
| Liquid Cleaners and Degreasers | 332311: Prefabricated Metal Building and Component Manufacturing | 750 employees | 641 | 622 | 730 | 27,283 | 17,323 | $1,741,103 | $8,357,363 |
| Liquid Cleaners and Degreasers; Paint and Coatings | 332313: Plate Work Manufacturing | 750 employees | 1,408 | 1,380 | 1,456 | 35,850 | 30,864 | $2,082,367 | $7,693,005 |
| Incorporation Into Formulation, Mixture, or Reaction Product; Glues, Sealants, Adhesives, and Caulks; Adhesive and Caulk Remover; Paint and Coatings | 332322: Sheet Metal Work Manufacturing | 500 employees | 3,752 | 3,670 | 4,045 | 106,102 | 82,263 | $6,218,738 | $25,138,685 |
| Liquid Cleaners and Degreasers | 332410: Power Boiler and Heat Exchanger Manufacturing | 750 employees | 268 | 236 | 313 | 22,770 | 11,080 | $1,738,364 | $7,620,387 |
| Liquid Cleaners and Degreasers | 332420: Metal Tank (Heavy Gauge) Manufacturing | 750 employees | 636 | 601 | 734 | 33,637 | 24,825 | $2,274,382 | $8,937,554 |
| Liquid Cleaners and Degreasers | 332431: Metal Can Manufacturing | 1,500 employees | 66 | 50 | 185 | 16,618 | 2,081 | $1,457,301 | $16,451,244 |
| Liquid Cleaners and Degreasers | 332439: Other Metal Container Manufacturing | 600 employees | 261 | 240 | 295 | 10,717 | 5,401 | $576,993 | $3,646,035 |
| Liquid Cleaners and Degreasers | 332510: Hardware Manufacturing | 750 employees | 568 | 541 | 614 | 28,626 | 15,980 | $1,545,695 | $9,315,792 |
| Liquid Cleaners and Degreasers | 332618: Other Fabricated Wire Product Manufacturing | 500 employees | 680 | 647 | 764 | 21,457 | 15,446 | $1,072,458 | $5,697,626 |
| Vapor Degreasing; Liquid Cleaners and Degreasers | 332721: Precision Turned Product Manufacturing | 500 employees | 3,670 | 3,582 | 3,791 | 103,249 | 81,265 | $6,270,901 | $20,785,700 |
| Liquid Cleaners and Degreasers | 332722: Bolt, Nut, Screw, Rivet, and Washer Manufacturing | 600 employees | 650 | 619 | 774 | 37,940 | 20,892 | $2,431,402 | $11,922,217 |
| Liquid Cleaners and Degreasers | 332811: Metal Heat Treating | 750 employees | 617 | 589 | 774 | 21,545 | 16,349 | $1,276,005 | $5,345,139 |
| Incorporation Into Formulation, Mixture, or Reaction Product; Liquid Cleaners and Degreasers; Paint and Coatings | 332812: Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers | 600 employees | 2,338 | 2,275 | 2,590 | 54,860 | 39,406 | $3,015,469 | $14,797,592 |
| Glues, Sealants, Adhesives, and Caulks; Vapor Degreasing; Liquid Cleaners and Degreasers; Adhesive and Caulk Remover; Paint and Coatings | 332813: Electroplating, Plating, Polishing, Anodizing, and Coloring | 500 employees | 2,068 | 2,032 | 2,169 | 51,056 | 42,608 | $2,606,525 | $7,880,339 |
| Liquid Cleaners and Degreasers | 332912: Fluid Power Valve and Hose Fitting Manufacturing | 1,000 employees | 294 | 261 | 363 | 36,324 | 12,240 | $2,598,303 | $11,871,014 |
| Liquid Cleaners and Degreasers | 332913: Plumbing Fixture Fitting and Trim Manufacturing | 1,000 employees | 94 | 87 | 106 | 8,536 | 3,854 | $546,787 | $5,307,063 |
| Liquid Cleaners and Degreasers | 332919: Other Metal Valve and Pipe Fitting Manufacturing | 750 employees | 217 | 189 | 232 | 13,100 | 7,569 | $863,380 | $4,267,418 |
| Paint and Coatings | 332993: Ammunition (except Small Arms) Manufacturing | 1,500 employees | 43 | 35 | 53 | 11,441 | 625 | $1,112,705 | $2,951,297 |
| Liquid Cleaners and Degreasers; Paint and Coatings | 332994: Small Arms, Ordnance, and Ordnance Accessories Manufacturing | 1,000 employees | 388 | 377 | 403 | 20,333 | 9,988 | $1,255,279 | $6,941,046 |
| Liquid Cleaners and Degreasers | 332996: Fabricated Pipe and Pipe Fitting Manufacturing | 550 employees | 644 | 606 | 712 | 27,077 | 17,665 | $1,797,196 | $7,066,544 |
| Glues, Sealants, Adhesives, and Caulks; Vapor Degreasing; Liquid Cleaners and Degreasers; Adhesive and Caulk Remover; Paint and Coatings | 332999: All Other Miscellaneous Fabricated Metal Product Manufacturing | 750 employees | 3,514 | 3,458 | 3,593 | 66,842 | 56,916 | $3,771,858 | $15,338,229 |
| Liquid Cleaners and Degreasers | 333120: Construction Machinery Manufacturing | 1,250 employees | 651 | 616 | 743 | 59,684 | 25,323 | $4,150,756 | $35,077,422 |
| Paint and Coatings | 333131: Mining Machinery and Equipment Manufacturing | 900 employees | 224 | 206 | 262 | 11,081 | 5,290 | $1,353,521 | $4,047,227 |
| Liquid Cleaners and Degreasers; Paint and Coatings | 333132: Oil and Gas Field Machinery and Equipment Manufacturing | 1,250 employees | 502 | 469 | 611 | 33,066 | 17,568 | $3,065,271 | $13,667,494 |
| Lithographic Printing Cleaner | 333244: Printing Machinery and Equipment Manufacturing | 750 employees | 263 | 257 | 277 | 7,215 | 5,922 | $431,718 | $2,074,087 |
| Liquid Cleaners and Degreasers | 333249: Other Industrial Machinery Manufacturing | 750 employees | 1,811 | 1,742 | 1,866 | 53,766 | 42,042 | $3,843,239 | $15,956,714 |
| Vapor Degreasing | 333310: Commercial and Service Industry Machinery Manufacturing | 1,000 employees | - | - | - | - | - | $ - | $ - |
| Liquid Cleaners and Degreasers | 333318: Other Commercial and Service Industry Machinery Manufacturing | 1,000 employees | 1,231 | 1,174 | 1,316 | 52,148 | 31,141 | $3,983,946 | $20,023,370 |
| Liquid Cleaners and Degreasers; Paint and Coatings | 333413: Industrial and Commercial Fan and Blower and Air Purification Equipment Manufacturing | 500 employees | 401 | 374 | 475 | 23,406 | 11,429 | $1,373,646 | $6,180,916 |
| Incorporation Into Formulation, Mixture, or Reaction Product; Liquid Cleaners and Degreasers | 333415: Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing | 1,250 employees | 705 | 653 | 841 | 89,119 | 28,842 | $5,161,167 | $35,427,977 |
| Liquid Cleaners and Degreasers | 333511: Industrial Mold Manufacturing | 500 employees | 1,392 | 1,347 | 1,442 | 35,364 | 27,243 | $2,031,478 | $7,012,321 |
| Liquid Cleaners and Degreasers | 333611: Turbine and Turbine Generator Set Units Manufacturing | 1,500 employees | 115 | 96 | 165 | 35,634 | 6,615 | $2,539,959 | $14,094,565 |
| Incorporation Into Formulation, Mixture, or Reaction Product; Paint and Coating Removers (Professional Contracting) | 333912: Air and Gas Compressor Manufacturing | 1,000 employees | 261 | 238 | 297 | 18,362 | 8,437 | $1,719,115 | $10,120,841 |
| Paint and Coatings | 333922: Conveyor and Conveying Equipment Manufacturing | 500 employees | 718 | 683 | 779 | 37,082 | 24,636 | $2,673,453 | $10,842,396 |
| Incorporation Into Formulation, Mixture, or Reaction Product | 333992: Welding and Soldering Equipment Manufacturing | 1,250 employees | 341 | 331 | 363 | 16,213 | 6,225 | $1,207,347 | $6,132,434 |
| Liquid Cleaners and Degreasers; Paint and Coatings | 333994: Industrial Process Furnace and Oven Manufacturing | 500 employees | 317 | 302 | 344 | 10,868 | 7,984 | $736,602 | $2,802,679 |
| Paint and Coatings | 333996: Fluid Power Pump and Motor Manufacturing | 1,250 employees | 132 | 116 | 157 | 10,484 | 4,092 | $823,030 | $4,762,026 |
| Import/Repackage; Incorporation Into Formulation, Mixture, or Reaction Product | 333998: All Other Miscellaneous General Purpose Machinery Manufacturing | 700 employees | - | - | - | - | - | $ - | $ - |
| Liquid Cleaners and Degreasers | 333999: All Other Miscellaneous General Purpose Machinery Manufacturing | 700 employees | 1,558 | 1,467 | 1,645 | 55,552 | 29,610 | $4,163,663 | $17,994,499 |
| Vapor Degreasing | 334111: Electronic Computer Manufacturing | 1,250 employees | 302 | 281 | 310 | 12,246 | 3,466 | $1,432,464 | $9,646,577 |
| Paint and Coatings | 334220: Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing | 1,250 employees | 658 | 619 | 725 | 63,557 | 19,253 | $6,000,302 | $27,780,230 |
| Glues, Sealants, Adhesives, and Caulks; Liquid Cleaners and Degreasers; Adhesive and Caulk Remover | 334310: Audio and Video Equipment Manufacturing | 750 employees | 462 | 452 | 474 | 8,902 | 7,276 | $715,761 | $3,098,673 |
| Liquid Cleaners and Degreasers | 334412: Bare Printed Circuit Board Manufacturing | 750 employees | 443 | 420 | 470 | 22,434 | 13,427 | $1,261,695 | $4,660,864 |
| Liquid Cleaners and Degreasers | 334413: Semiconductor and Related Device Manufacturing | 1,250 employees | 733 | 682 | 812 | 97,959 | 25,678 | $12,530,382 | $54,479,509 |
| Liquid Cleaners and Degreasers | 334416: Capacitor, Resistor, Coil, Transformer, and Other Inductor Manufacturing | 550 employees | 334 | 311 | 371 | 17,270 | 9,717 | $1,058,395 | $3,960,558 |
| Liquid Cleaners and Degreasers | 334417: Electronic Connector Manufacturing | 1,000 employees | 161 | 144 | 204 | 18,962 | 7,153 | $1,508,161 | $6,554,001 |
| Liquid Cleaners and Degreasers | 334419: Other Electronic Component Manufacturing | 750 employees | 1,131 | 1,059 | 1,236 | 51,084 | 28,209 | $3,513,204 | $13,420,385 |
| Liquid Cleaners and Degreasers | 334510: Electromedical and Electrotherapeutic Apparatus Manufacturing | 1,250 employees | 755 | 690 | 857 | 75,438 | 24,539 | $8,668,059 | $35,473,653 |
| Liquid Cleaners and Degreasers | 334511: Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing | 1,350 employees | 421 | 379 | 549 | 126,636 | 10,417 | $13,379,837 | $55,924,771 |
| Liquid Cleaners and Degreasers | 334512: Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use | 650 employees | 261 | 234 | 274 | 12,197 | 5,237 | $918,465 | $3,278,353 |
| Liquid Cleaners and Degreasers | 334513: Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables | 750 employees | 750 | 710 | 816 | 33,789 | 16,453 | $2,731,671 | $11,894,298 |
| Liquid Cleaners and Degreasers | 334515: Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals | 750 employees | 710 | 664 | 753 | 30,275 | 13,750 | $3,509,169 | $12,641,143 |
| Import/Repackage | 334516: Analytical Laboratory Instrument Manufacturing | 1,000 employees | 608 | 558 | 689 | 48,780 | 16,728 | $4,651,261 | $18,580,850 |
| Liquid Cleaners and Degreasers | 334519: Other Measuring and Controlling Device Manufacturing | 600 employees | 828 | 766 | 902 | 35,395 | 17,270 | $3,270,948 | $13,110,920 |
| Liquid Cleaners and Degreasers | 335121: Residential Electric Lighting Fixture Manufacturing | 750 employees | 258 | 253 | 262 | 6,300 | 3,363 | $316,803 | $1,883,145 |
| Liquid Cleaners and Degreasers; Paint and Coatings | 335312: Motor and Generator Manufacturing | 1,250 employees | 372 | 339 | 424 | 28,980 | 9,911 | $1,859,786 | $10,882,672 |
| Liquid Cleaners and Degreasers | 335313: Switchgear and Switchboard Apparatus Manufacturing | 1,250 employees | 413 | 390 | 484 | 31,048 | 13,584 | $2,260,960 | $12,968,695 |
| Glues, Sealants, Adhesives, and Caulks; Liquid Cleaners and Degreasers; Adhesive and Caulk Remover | 335911: Storage Battery Manufacturing | 1,250 employees | 123 | 112 | 164 | 22,805 | 7,104 | $1,537,863 | $8,158,536 |
| Liquid Cleaners and Degreasers | 335921: Fiber Optic Cable Manufacturing | 1,000 employees | 87 | 77 | 92 | 6,974 | 2,683 | $453,570 | $3,226,580 |
| Liquid Cleaners and Degreasers | 335929: Other Communication and Energy Wire Manufacturing | 1,000 employees | 186 | 159 | 229 | 17,536 | 7,190 | $1,140,342 | $9,414,938 |
| Liquid Cleaners and Degreasers | 335999: All Other Miscellaneous Electrical Equipment and Component Manufacturing | 600 employees | 783 | 724 | 819 | 30,870 | 15,752 | $3,090,558 | $11,565,186 |
| Liquid Cleaners and Degreasers | 336111: Automobile Manufacturing | 1,500 employees | 162 | 144 | 175 | 82,780 | 2,754 | $7,841,342 | $114,962,621 |
| Liquid Cleaners and Degreasers; Paint and Coatings | 336211: Motor Vehicle Body Manufacturing | 1,000 employees | 632 | 590 | 733 | 47,964 | 20,101 | $2,773,096 | $15,869,176 |
| Paint and Coatings | 336212: Truck Trailer Manufacturing | 1,000 employees | 379 | 363 | 432 | 37,081 | 17,618 | $1,882,296 | $12,137,479 |
| Paint and Coatings | 336213: Motor Home Manufacturing | 1,250 employees | 41 | 36 | 49 | 11,943 | 1,761 | $647,796 | $6,063,979 |
| Paint and Coatings | 336214: Travel Trailer and Camper Manufacturing | 1,000 employees | 601 | 585 | 729 | 54,221 | 17,342 | $2,879,703 | $19,472,257 |
| Liquid Cleaners and Degreasers | 336310: Motor Vehicle Gasoline Engine and Engine Parts Manufacturing | 1,050 employees | 706 | 654 | 758 | 58,120 | 16,149 | $4,395,888 | $36,037,522 |
| Liquid Cleaners and Degreasers | 336340: Motor Vehicle Brake System Manufacturing | 1,250 employees | 139 | 118 | 179 | 23,359 | 9,684 | $1,308,446 | $12,411,690 |
| Vapor Degreasing | 336370: Motor Vehicle Metal Stamping | 1,000 employees | 597 | 550 | 757 | 107,888 | 53,521 | $6,392,830 | $40,171,047 |
| Paint and Coatings | 336390: Other Motor Vehicle Parts Manufacturing | 1,000 employees | 1,268 | 1,145 | 1,483 | 148,076 | 56,090 | $8,549,418 | $69,627,533 |
| Glues, Sealants, Adhesives, and Caulks; Liquid Cleaners and Degreasers; Adhesive and Caulk Remover | 336411: Aircraft Manufacturing | 1,500 employees | 262 | 236 | 317 | 166,716 | 10,736 | $18,433,958 | $160,386,600 |
| Vapor Degreasing; Liquid Cleaners and Degreasers | 336413: Other Aircraft Parts and Auxiliary Equipment Manufacturing | 1,250 employees | 750 | 692 | 921 | 103,133 | 26,327 | $8,951,649 | $38,108,949 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding; | 336414: Guided Missile and Space Vehicle Manufacturing | 1,300 employees | 22 | 12 | 42 | 35,386 | 679 | $5,600,223 | $17,795,004 |
| Liquid Cleaners and Degreasers | 336510: Railroad Rolling Stock Manufacturing | 1,500 employees | 153 | 131 | 229 | 29,532 | 6,983 | $2,066,153 | $14,046,790 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | 336611: Ship Building and Repairing | 1,300 employees | 503 | 478 | 588 | 99,963 | 22,304 | $7,060,944 | $27,448,088 |
| Glues, Sealants, Adhesives, and Caulks; Liquid Cleaners and Degreasers; Paint and Coating Removers (Pleasure Craft Building and Repairing); Adhesive and Caulk Remover | 336612: Boat Building | 1,000 employees | 833 | 815 | 875 | 37,337 | 23,117 | $1,945,649 | $11,250,129 |
| Furniture Refinishing; Glues, Sealants, Adhesives, and Caulks; Adhesive and Caulk Remover | 337110: Wood Kitchen Cabinet and Countertop Manufacturing | 750 employees | 5,907 | 5,886 | 5,981 | 91,250 | 62,626 | $4,015,062 | $15,741,298 |
| Furniture Refinishing; Glues, Sealants, Adhesives, and Caulks; Adhesive and Caulk Remover; Paint and Coatings | 337121: Upholstered Household Furniture Manufacturing | 1,000 employees | 963 | 941 | 1,051 | 65,529 | 29,353 | $2,617,675 | $13,263,744 |
| Furniture Refinishing; Liquid Cleaners and Degreasers; Paint and Coatings | 337122: Nonupholstered Wood Household Furniture Manufacturing | 750 employees | 2,024 | 2,014 | 2,049 | 26,512 | 20,648 | $878,352 | $4,345,390 |
| Liquid Cleaners and Degreasers | 337125: Household Furniture (except Wood and Upholstered) Manufacturing | 950 employees | 156 | 152 | 158 | 3,153 | 1,922 | $133,637 | $1,251,221 |
| Furniture Refinishing; Liquid Cleaners and Degreasers | 337127: Institutional Furniture Manufacturing | 500 employees | 574 | 554 | 596 | 24,464 | 18,646 | $1,213,329 | $5,396,714 |
| Glues, Sealants, Adhesives, and Caulks; Adhesive and Caulk Remover; Paint and Coatings | 337211: Wood Office Furniture Manufacturing | 1,000 employees | 307 | 294 | 320 | 13,183 | 6,426 | $599,894 | $2,879,115 |
| Furniture Refinishing | 337214: Office Furniture (except Wood) Manufacturing | 1,100 employees | 194 | 181 | 217 | 22,841 | 6,307 | $1,404,257 | $8,881,454 |
| Paint and Coatings | 337215: Showcase, Partition, Shelving, and Locker Manufacturing | 500 employees | 901 | 863 | 942 | 34,322 | 21,450 | $1,668,749 | $7,792,485 |
| Incorporation Into Formulation, Mixture, or Reaction Product; Liquid Cleaners and Degreasers | 339112: Surgical and Medical Instrument Manufacturing | 1,000 employees | 1,063 | 995 | 1,234 | 109,121 | 36,227 | $9,943,763 | $43,456,733 |
| Liquid Cleaners and Degreasers | 339113: Surgical Appliance and Supplies Manufacturing | 800 employees | 1,651 | 1,592 | 1,867 | 86,837 | 38,259 | $7,165,283 | $39,785,303 |
| Liquid Cleaners and Degreasers | 339114: Dental Equipment and Supplies Manufacturing | 750 employees | 557 | 544 | 579 | 15,040 | 8,167 | $1,099,109 | $5,372,641 |
| Liquid Cleaners and Degreasers | 339910: Jewelry and Silverware Manufacturing | 700 employees | 1,967 | 1,954 | 1,986 | 23,813 | 16,523 | $1,130,380 | $7,920,751 |
| Glues, Sealants, Adhesives, and Caulks; Liquid Cleaners and Degreasers; Adhesive and Caulk Remover; Lubricants and Greases | 339920: Sporting and Athletic Goods Manufacturing | 750 employees | 1,586 | 1,567 | 1,649 | 39,326 | 27,983 | $2,039,980 | $11,316,216 |
| Incorporation Into Formulation, Mixture, or Reaction Product | 339940: Office Supplies (except Paper) Manufacturing | 750 employees | 423 | 409 | 449 | 11,689 | 8,072 | $594,668 | $3,499,464 |
| Glues, Sealants, Adhesives, and Caulks; Paint and Coating Removers (Automotive Repair and Refinishing); Adhesive and Caulk Remover; Paint and Coatings | 339950: Sign Manufacturing | 500 employees | 5,602 | 5,572 | 5,727 | 76,353 | 64,832 | $4,027,381 | $13,963,312 |
| Paint and Coatings | 339991: Gasket, Packing, and Sealing Device Manufacturing | 600 employees | 490 | 449 | 562 | 28,575 | 10,851 | $2,701,797 | $7,845,149 |
| Glues, Sealants, Adhesives, and Caulks; Liquid Cleaners and Degreasers; Adhesive and Caulk Remover | 339992: Musical Instrument Manufacturing | 1,000 employees | 585 | 582 | 606 | 11,412 | 9,214 | $582,648 | $2,168,146 |
| Paint and Coatings | 339993: Fastener, Button, Needle, and Pin Manufacturing | 750 employees | 103 | 97 | 110 | 3,992 | 1,595 | $222,049 | $982,204 |
| Liquid Cleaners and Degreasers | 339995: Burial Casket Manufacturing | 1,000 employees | 82 | 78 | 97 | 3,514 | 1,207 | $151,438 | $625,740 |
| Import/Repackage; Incorporation Into Formulation, Mixture, or Reaction Product; Liquid Cleaners and Degreasers; Paint and Coating Removers (Art Restoration) | 339999: All Other Miscellaneous Manufacturing | 550 employees | 5,738 | 5,681 | 5,755 | 52,935 | 41,053 | $2,326,186 | $13,286,622 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | 423120: Motor Vehicle Supplies and New Parts Merchant Wholesalers | 200 employees | 8,342 | 7,904 | 13,079 | 212,705 | 78,107 | $13,029,143 | $210,352,095 |
| Furniture Refinishing | 423210: Furniture Merchant Wholesalers | 100 employees | 5,117 | 4,896 | 5,854 | 71,151 | 40,723 | $5,128,353 | $55,400,214 |
| Furniture Refinishing | 423420: Office Equipment Merchant Wholesalers | 200 employees | 2,265 | 2,188 | 8,808 | 117,242 | 30,724 | $7,804,463 | $42,256,656 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | 423490: Other Professional Equipment and Supplies Merchant Wholesalers | 150 employees | 2,111 | 2,031 | 2,574 | 37,701 | 16,613 | $3,003,638 | $23,781,833 |
| Incorporation Into Formulation, Mixture, or Reaction Product | 423830: Industrial Machinery and Equipment Merchant Wholesalers | 100 employees | 22,424 | 21,246 | 29,485 | 370,240 | 172,848 | $31,251,996 | $264,526,684 |
| Incorporation Into Formulation, Mixture, or Reaction Product | 423840: Industrial Supplies Merchant Wholesalers | 125 employees | 5,811 | 5,495 | 9,463 | 105,490 | 52,940 | $8,183,772 | $84,157,986 |
| Incorporation Into Formulation, Mixture, or Reaction Product | 423850: Service Establishment Equipment and Supplies Merchant Wholesalers | 125 employees | 3,195 | 3,079 | 4,763 | 52,245 | 27,519 | $3,128,618 | $24,035,372 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | 423910: Sporting and Recreational Goods and Supplies Merchant Wholesalers | 100 employees | 4,689 | 4,498 | 5,393 | 60,133 | 30,242 | $4,267,037 | $48,430,775 |
| Furniture Refinishing; Vapor Degreasing | 423990: Other Miscellaneous Durable Goods Merchant Wholesalers | 100 employees | 8,605 | 8,376 | 9,310 | 82,782 | 45,288 | $5,425,705 | $48,517,578 |
| Manufacturing; Import/Repackage; Incorporation Into Formulation, Mixture, or Reaction Product; Processing Aid, Plastics Manufacturing, and Solvent Welding; Vapor Degreasing; Paint and Coating Removers (Professional Contracting); Paint and Coatings | 424690: Other Chemical and Allied Products Merchant Wholesalers | 175 employees | 6,069 | 5,767 | 9,418 | 126,009 | 50,790 | $11,458,083 | $216,231,766 |
| Incorporation Into Formulation, Mixture, or Reaction Product | 424910: Farm Supplies Merchant Wholesalers | 200 employees | 4,965 | 4,771 | 9,216 | 107,655 | 43,048 | $7,781,822 | $156,864,518 |
| Aerosol Spray Cleaning/DegreasingPaint and Coating Removers (Automotive Repair and Refinishing); Paint and Coatings | 441110: New Car Dealers | 200 employees | 17,423 | 16,559 | 21,636 | 1,177,984 | 750,891 | $70,608,238 | $996,115,514 |
| Aerosol Spray Cleaning/Degreasing; Paint and Coating Removers (Automotive Repair and Refinishing) | 441120: Used Car Dealers | $30.5m revenue | 23,627 | 22,991 | 25,512 | 154,136 | 94,791 | $7,537,715 | $111,580,346 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing); Paint and Coatings | 441222: Boat Dealers | $40m revenue | 3,569 | 3,521 | 4,231 | 33,163 | 25,178 | $1,714,118 | $16,803,273 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | 441310: Automotive Parts and Accessories Retailers | $28.5m revenue | 16,627 | 16,400 | 37,553 | 360,519 | 104,810 | $10,610,277 | $63,670,948 |
| Furniture Refinishing | 442110: Furniture Stores | $25 million | 13,826 | 13,542 | 23,615 | 208,946 | 97,202 | $8,657,088 | $65,925,283 |
| Paint and Coating Removers (Bathtub Refinishing) | 442210: Floor Covering Retailers | $9m revenue | 9,312 | 8,863 | 11,200 | 70,436 | 44,631 | $3,492,943 | $24,186,061 |
| Furniture Refinishing | 442299: All Other Home Furnishings Retailers | $33.5m revenue | 7,867 | 7,790 | 14,008 | 173,781 | 37,389 | $3,612,668 | $31,532,608 |
| Aerosol Spray Cleaning/Degreasing | 443141: Household Appliance Stores | $40 million | 5,430 | 5,349 | 7,344 | 60,994 | 37,121 | $2,360,789 | $18,377,840 |
| Import/Repackage; Paint and Coating Removers (Professional Contracting) | 444120: Paint and Wallpaper Stores | $34m revenue | 1,623 | 1,593 | 7,037 | 35,427 | 9,387 | $1,872,595 | $12,468,237 |
| Paint and Coating Removers (Bathtub Refinishing) | 444190: Other Building Material Dealers | $25 million | 22,831 | 21,828 | 29,485 | 278,581 | 176,381 | $14,699,275 | $109,332,866 |
| Aerosol Spray Cleaning/Degreasing | 447110: Gasoline Stations with Convenience Stores | $36.5m revenue | 56,985 | 55,925 | 98,642 | 794,401 | 350,953 | $18,630,155 | $412,581,926 |
| Aerosol Spray Cleaning/Degreasing | 447190: Other Gasoline Stations | $33.5m revenue | 10,066 | 9,343 | 14,224 | 149,516 | 57,872 | $3,841,230 | $100,878,485 |
| Aerosol Spray Cleaning/DegreasingLubricants and Greases | 451110: Sporting Goods Retailers | $26.5m revenue | 16,233 | 16,102 | 21,422 | 240,816 | 96,677 | $5,750,710 | $49,367,543 |
| Furniture Refinishing | 451130: Sewing, Needlework, and Piece Goods Retailers | $34m revenue | 3,126 | 3,126 | 4,079 | 39,181 | 39,181 | $558,981 | $4,129,620 |
| Furniture Refinishing | 451140: Musical Instrument and Supplies Retailers | $22.5m revenue | 2,695 | 2,688 | 3,557 | 28,182 | 27,570 | $824,987 | $4,889,431 |
| Furniture Refinishing; Paint and Coating Removers (Art Restoration) | 453310: Used Merchandise Stores | $14 million | 14,019 | 13,690 | 20,350 | 199,693 | 86,537 | $4,383,290 | $16,775,945 |
| Paint and Coating Removers (Art Restoration) | 453920: Art Dealers | $16.5m revenue | 4,629 | 4,535 | 4,920 | 18,036 | 13,291 | $1,170,778 | $10,963,007 |
| Paint and Coating Removers (Art Restoration) | 453998: All Other Miscellaneous Store Retailers (except Tobacco Stores) | $11.5 million | 17,490 | 17,197 | 21,350 | 99,931 | 80,069 | $3,979,849 | $21,033,883 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | 455219: All Other General Merchandise Retailers | $40 million | - | - | - | - | - | $- | $- |
| Glues, Sealants, Adhesives, and Caulks; Aerosol Spray Cleaning/DegreasingAdhesive and Caulk Remover; Paint and Coatings | 481111: Scheduled Passenger Air Transportation | 1,500 employees | 306 | 274 | 1,872 | 421,206 | 12,988 | $40,926,378 | $189,441,361 |
| Aerosol Spray Cleaning/Degreasing; | 481112: Scheduled Freight Air Transportation | 1,500 employees | 183 | 172 | 375 | 9,161 | 4,462 | $727,967 | $6,553,119 |
| Aerosol Spray Cleaning/Degreasing | 481211: Nonscheduled Chartered Passenger Air Transportation | 1,500 employees | 1,326 | 1,278 | 1,491 | 29,111 | 18,487 | $3,492,538 | $16,139,597 |
| Aerosol Spray Cleaning/Degreasing | 481212: Nonscheduled Chartered Freight Air Transportation | 1,500 employees | 172 | 164 | 203 | 5,232 | 3,366 | $630,690 | $4,969,424 |
| Aerosol Spray Cleaning/Degreasing | 481219: Other Nonscheduled Air Transportation | $25m revenue | 457 | 429 | 500 | 5,643 | 2,324 | $602,035 | $2,257,565 |
| Aerosol Spray Cleaning/Degreasing | 483111: Deep Sea Freight Transportation | 1,050 employees | 190 | 180 | 276 | 6,515 | 2,108 | $697,832 | $6,787,428 |
| Aerosol Spray Cleaning/Degreasing | 483112: Deep Sea Passenger Transportation | 1,500 employees | 60 | 56 | 69 | 15,128 | 749 | $1,449,209 | $22,314,866 |
| Aerosol Spray Cleaning/Degreasing | 483113: Coastal and Great Lakes Freight Transportation | 800 employees | 353 | 331 | 581 | 17,799 | 10,522 | $1,813,201 | $8,448,405 |
| Aerosol Spray Cleaning/Degreasing | 483114: Coastal and Great Lakes Passenger Transportation | 550 employees | 141 | 139 | 150 | 2,008 | 1,773 | $169,539 | $619,959 |
| Aerosol Spray Cleaning/Degreasing | 483211: Inland Water Freight Transportation | 1,050 employees | 271 | 257 | 314 | 17,312 | 7,461 | $1,491,151 | $6,629,718 |
| Aerosol Spray Cleaning/Degreasing | 483212: Inland Water Passenger Transportation | 550 employees | 255 | 251 | 278 | 3,000 | 2,713 | $196,375 | $618,483 |
| Aerosol Spray Cleaning/Degreasing | 484110: General Freight Trucking, Local | $34m revenue | 29,915 | 29,593 | 31,490 | 192,717 | 144,013 | $10,919,010 | $35,756,566 |
| Aerosol Spray Cleaning/Degreasing | 484121: General Freight Trucking, Long-Distance, Truckload | $34m revenue | 31,913 | 31,203 | 37,029 | 510,943 | 179,361 | $28,895,734 | $122,615,239 |
| Aerosol Spray Cleaning/Degreasing | 484122: General Freight Trucking, Long-Distance, Less Than Truckload | $43m revenue | 4,368 | 4,242 | 8,314 | 270,212 | 26,047 | $18,586,019 | $51,191,850 |
| Furniture Refinishing; Aerosol Spray Cleaning/Degreasing | 484210: Used Household and Office Goods Moving | $34m revenue | 7,641 | 7,562 | 8,417 | 98,040 | 80,590 | $3,967,500 | $17,241,363 |
| Aerosol Spray Cleaning/Degreasing | 484220: Specialized Freight (except Used Goods) Trucking, Local | $34m revenue | 29,670 | 29,209 | 30,872 | 220,682 | 169,886 | $13,015,132 | $48,042,594 |
| Aerosol Spray Cleaning/Degreasing | 484230: Specialized Freight (except Used Goods) Trucking, Long-Distance | $34m revenue | 9,202 | 8,756 | 10,864 | 172,446 | 64,114 | $10,731,447 | $43,976,449 |
| Glues, Sealants, Adhesives, and Caulks; Aerosol Spray Cleaning/DegreasingAdhesive and Caulk Remover | 485111: Mixed Mode Transit Systems | $29m revenue | 35 | 35 | 36 | 684 | 684 | $38,968 | $121,236 |
| Aerosol Spray Cleaning/Degreasing; | 485113: Bus and Other Motor Vehicle Transit Systems | $32.5m revenue | 465 | 434 | 760 | 52,585 | 10,350 | $2,555,342 | $4,827,568 |
| Aerosol Spray Cleaning/Degreasing | 485119: Other Urban Transit Systems | $37.5m revenue | 183 | 177 | 190 | 2,115 | 1,553 | $91,775 | $392,861 |
| Aerosol Spray Cleaning/Degreasing | 485210: Interurban and Rural Bus Transportation | $32m revenue | 543 | 534 | 806 | 20,635 | 11,985 | $697,118 | $2,380,919 |
| Aerosol Spray Cleaning/Degreasing | 485310: Taxi Service | $19m revenue | 3,151 | 3,114 | 3,266 | 43,991 | 20,696 | $4,723,638 | $12,542,894 |
| Aerosol Spray Cleaning/Degreasing | 485410: School and Employee Bus Transportation | $30m revenue | 2,610 | 2,535 | 4,275 | 224,335 | 80,001 | $6,292,531 | $11,621,887 |
| Aerosol Spray Cleaning/Degreasing | 485510: Charter Bus Industry | $19m revenue | 1,153 | 1,107 | 1,273 | 32,067 | 21,225 | $1,155,658 | $3,788,468 |
| Aerosol Spray Cleaning/Degreasing | 485991: Special Needs Transportation | $19m revenue | 3,048 | 2,921 | 3,333 | 74,177 | 43,540 | $2,346,932 | $6,035,931 |
| Aerosol Spray Cleaning/Degreasing | 485999: All Other Transit and Ground Passenger Transportation | $19m revenue | 1,596 | 1,556 | 1,821 | 23,434 | 14,950 | $756,611 | $2,067,881 |
| Aerosol Spray Cleaning/Degreasing | 486110: Pipeline Transportation of Crude Oil | 1,500 employees | 80 | 55 | 802 | 13,412 | 1,468 | $1,482,260 | $11,065,974 |
| Aerosol Spray Cleaning/Degreasing | 486210: Pipeline Transportation of Natural Gas | $41.5m revenue | 128 | 67 | 2,176 | 29,504 | 341 | $3,498,927 | $31,775,990 |
| Aerosol Spray Cleaning/Degreasing | 486910: Pipeline Transportation of Refined Petroleum Products | 1,500 employees | 68 | 45 | 654 | 8,123 | 1,606 | $1,145,176 | $9,769,060 |
| Aerosol Spray Cleaning/Degreasing | 487110: Scenic and Sightseeing Transportation, Land | $20.5m revenue | 686 | 663 | 738 | 11,458 | 7,039 | $433,060 | $1,422,127 |
| Aerosol Spray Cleaning/Degreasing | 487210: Scenic and Sightseeing Transportation, Water | $14m revenue | 1,768 | 1,736 | 1,817 | 14,542 | 8,979 | $723,393 | $2,317,090 |
| Aerosol Spray Cleaning/Degreasing | 487990: Scenic and Sightseeing Transportation, Other | $25m revenue | 309 | 302 | 343 | 3,611 | 2,154 | $183,168 | $837,595 |
| Aerosol Spray Cleaning/DegreasingPaint and Coatings | 488119: Other Airport Operations | $40m revenue | 1,096 | 1,006 | 2,013 | 113,159 | 19,016 | $4,262,293 | $9,540,869 |
| Aerospace Paint and Coating Removers; Aerosol Spray Cleaning/Degreasing; Paint and Coatings | 488190: Other Support Activities for Air Transportation | $40m revenue | 3,197 | 3,052 | 3,894 | 85,531 | 30,184 | $6,448,937 | $19,794,195 |
| Aerosol Spray Cleaning/Degreasing; | 488210: Support Activities for Rail Transportation | $34m revenue | 564 | 476 | 1,543 | 40,907 | 6,826 | $2,464,479 | $6,613,229 |
| Aerosol Spray Cleaning/Degreasing | 488310: Port and Harbor Operations | $47m revenue | 261 | 213 | 335 | 9,005 | 3,493 | $854,591 | $2,989,208 |
| Aerosol Spray Cleaning/Degreasing | 488320: Marine Cargo Handling | $47m revenue | 275 | 220 | 480 | 58,663 | 8,949 | $5,214,598 | $10,738,579 |
| Aerosol Spray Cleaning/Degreasing | 488330: Navigational Services to Shipping | $47m revenue | 860 | 819 | 1,032 | 13,635 | 6,760 | $1,284,992 | $4,155,549 |
| Aerosol Spray Cleaning/Degreasing | 488390: Other Support Activities for Water Transportation | $47m revenue | 708 | 677 | 834 | 9,472 | 6,195 | $524,796 | $2,281,619 |
| Aerosol Spray Cleaning/DegreasingPaint and Coating Removers (Automotive Repair and Refinishing) | 488410: Motor Vehicle Towing | $9m revenue | 8,913 | 8,836 | 9,211 | 62,317 | 55,518 | $2,800,297 | $7,970,905 |
| Aerosol Spray Cleaning/Degreasing; | 488490: Other Support Activities for Road Transportation | $18m revenue | 1,773 | 1,668 | 3,294 | 42,225 | 14,117 | $1,573,147 | $3,829,657 |
| Aerosol Spray Cleaning/Degreasing | 488510: Freight Transportation Arrangement | $20m revenue | 15,104 | 14,258 | 21,395 | 265,192 | 98,587 | $19,123,940 | $71,016,694 |
| Aerosol Spray Cleaning/Degreasing | 488991: Packing and Crating | $34m revenue | 1,309 | 1,269 | 1,401 | 15,506 | 12,740 | $713,643 | $2,364,727 |
| Aerosol Spray Cleaning/Degreasing | 488999: All Other Support Activities for Transportation | $25m revenue | 316 | 309 | 322 | 1,383 | 1,092 | $290,707 | $390,091 |
| Liquid Cleaners and Degreasers | 493110: General Warehousing and Storage | $34m revenue | 5,827 | 4,156 | 12,317 | 793,154 | 69,772 | $43,270,765 | $26,855,429 |
| Lithographic Printing Cleaner | 511110: Newspaper Publishers | 1,000 employees | 4,206 | - | 7,222 | 169,421 | - | $7,173,124 | $28,258,848 |
| Incorporation Into Formulation, Mixture, or Reaction Product | 523150: Investment Banking and Securities Intermediation | $47m revenue | - | - | - | - | - | $ - | $ - |
| Import/Repackage; Incorporation Into Formulation, Mixture, or Reaction Product; Processing Aid, Plastics Manufacturing, and Solvent Welding; Vapor Degreasing | 523910: Miscellaneous Intermediation | $47m revenue | 8,378 | 8,107 | 8,611 | 47,197 | 32,619 | $10,550,146 | $30,865,309 |
| Incorporation Into Formulation, Mixture, or Reaction Product; Vapor Degreasing | 523940: Portfolio Management and Investment Advice | $47m revenue | - | - | - | - | - | $ - | $ - |
| Laboratory Use | 541380: Testing Laboratories | $19m revenue | 5,283 | 4,963 | 7,075 | 134,605 | 52,681 | $10,399,483 | $22,790,307 |
| Furniture Refinishing; Paint and Coating Removers (Professional Contracting) | 541410: Interior Design Services | $9m revenue | 13,086 | 12,888 | 13,284 | 44,572 | 34,865 | $2,912,029 | $13,520,019 |
| Import/Repackage; | 541511: Custom Computer Programming Services | $34m revenue | 62,205 | 60,916 | 66,911 | 839,552 | 375,024 | $101,216,593 | $213,713,992 |
| Furniture Refinishing | 541611: Administrative Management and General Management Consulting Services | $24.5m revenue | 73,910 | 72,784 | 78,449 | 595,044 | 247,887 | $73,502,900 | $145,268,921 |
| Liquid Cleaners and Degreasers; Paint and Coatings | 541714: Research and Development in Biotechnology (except Nanobiotechnology) | 1,000 employees | 3,109 | 3,056 | 3,415 | 88,706 | 58,308 | $19,990,042 | $26,969,528 |
| Liquid Cleaners and Degreasers | 541715: Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology) | 1,000 employees | 8,019 | 7,641 | 10,032 | 465,680 | 147,517 | $69,012,984 | $106,413,105 |
| Paint and Coating Removers (graffiti Removal) | 561210: Facilities Support Services | $47m revenue | 2,145 | 1,801 | 6,720 | 281,222 | 60,135 | $13,164,271 | $31,939,651 |
| Manufacturing | 561499: All Other Business Support Services | $21.5m revenue | 3,674 | 3,502 | 4,153 | 58,107 | 20,788 | $3,612,734 | $10,243,153 |
| Furniture Refinishing; Paint and Coating Removers (Professional Contracting) | 561720: Janitorial Services | $22m revenue | 55,615 | 55,214 | 60,280 | 1,063,638 | 604,605 | $26,252,280 | $54,625,795 |
| Paint and Coating Removers (Professional Contracting) | 561730: Landscaping Services | $9.5m revenue | 102,354 | 101,417 | 104,337 | 663,818 | 460,743 | $31,397,361 | $84,530,790 |
| Furniture Refinishing; Paint and Coating Removers (Professional Contracting) | 561740: Carpet and Upholstery Cleaning Services | $8.5m revenue | 7,306 | 7,259 | 7,501 | 36,361 | 33,045 | $1,317,323 | $3,759,260 |
| Paint and Coating Removers (Professional Contracting) | 561790: Other Services to Buildings and Dwellings | $9m revenue | 13,604 | 13,510 | 13,743 | 68,418 | 57,126 | $3,171,832 | $8,793,291 |
| Incorporation Into Formulation, Mixture, or Reaction Product | 561910: Packaging and Labeling Services | $19.5m revenue | 1,470 | 1,326 | 1,664 | 42,948 | 18,448 | $2,054,270 | $8,321,140 |
| Furniture Refinishing; Paint and Coating Removers (Bathtub Refinishing); Paint and Coating Removers (Professional Contracting) | 561990: All Other Support Services | $16.5m revenue | 11,609 | 11,203 | 13,188 | 152,016 | 70,546 | $7,496,350 | $24,930,213 |
| Waste Handling, Disposal, Treatment, and Recycling | 562211: Hazardous Waste Treatment and Disposal | $47m revenue | 414 | 359 | 873 | 34,341 | 3,475 | $2,606,144 | $9,790,621 |
| Waste Handling, Disposal, Treatment, and Recycling | 562213: Solid Waste Combustors and Incinerators | $47m revenue | 37 | 26 | 61 | 2,095 | 88 | $212,175 | $1,436,082 |
| Waste Handling, Disposal, Treatment, and Recycling | 562920: Materials Recovery Facilities | $25m revenue | 1,004 | 900 | 1,389 | 20,279 | 11,156 | $1,060,720 | $6,977,719 |
| Lithographic Printing Cleaner; Paint and Coatings | 611310: Colleges, Universities, and Professional Schools | $34.5m revenue | 2,433 | 1,463 | 4,450 | 1,867,444 | 88,804 | $91,085,351 | $280,792,014 |
| Laboratory Use | 621511: Medical Laboratories | $41.5m revenue | 3,365 | 3,077 | 10,541 | 198,918 | 42,477 | $13,044,425 | $39,173,817 |
| Furniture Refinishing; Paint and Coating Removers (Art Restoration) | 711510: Independent Artists, Writers, and Performers | $9m revenue | 28,735 | 28,374 | 28,786 | 50,228 | 43,835 | $9,972,089 | $21,965,481 |
| Paint and Coating Removers (Art Restoration) | 712110: Museums | $34m revenue | 5,106 | 5,002 | 5,270 | 97,351 | 63,200 | $3,839,524 | $14,746,775 |
| Aerosol Spray Cleaning/Degreasing; Paint and Coating Removers (Automotive Repair and Refinishing); Paint and Coatings; Lubricants and Greases | 811111: General Automotive Repair | $9m revenue | 79,072 | 78,287 | 83,216 | 358,905 | 307,596 | $15,887,601 | $56,112,386 |
| Aerosol Spray Cleaning/Degreasing; Lubricants and Greases | 811112: Specialized Automotive Repair | $9m revenue | 1,521 | 1,521 | 1,575 | 4,996 | 4,996 | $174,453 | $669,650 |
| Aerosol Spray Cleaning/Degreasing; Lubricants and Greases; Cold Pipe Insulation | 811113: Specialized Automotive Repair | $9m revenue | 4,206 | 4,196 | 4,320 | 16,300 | 15,939 | $660,654 | $2,426,848 |
| Aerosol Spray Cleaning/Degreasing; Paint and Coating Removers (Automotive Repair and Refinishing); Lubricants and Greases; Antispatter Welding Aerosol | 811118: Specialized Automotive Repair | $9m revenue | 3,027 | 3,000 | 3,384 | 14,620 | 12,218 | $584,325 | $2,225,696 |
| Furniture Refinishing; Liquid Cleaners and Degreasers; Aerosol Spray Cleaning/Degreasing; Paint and Coating Removers (Automotive Repair and Refinishing); Paint and Coatings; Lubricants and Greases; Antispatter Welding Aerosol | 811121: Automotive Body, Paint, and Interior Repair and Maintenance | $9m revenue | 32,696 | 32,098 | 35,387 | 243,020 | 180,877 | $13,191,533 | $42,072,196 |
| Aerosol Spray Cleaning/Degreasing; Paint and Coating Removers (Automotive Repair and Refinishing); Lubricants and Greases | 811122: Automotive Glass Replacement Shops | $17.5m revenue | 4,764 | 4,744 | 6,051 | 29,811 | 28,419 | $1,487,170 | $4,706,249 |
| Aerosol Spray Cleaning/Degreasing; Lubricants and Greases | 811191: Automotive Oil Change and Lubrication Shops | $11m revenue | 4,467 | 4,368 | 8,236 | 61,501 | 32,632 | $1,915,981 | $6,381,580 |
| Aerosol Spray Cleaning/Degreasing; Paint and Coating Removers (Automotive Repair and Refinishing); Lubricants and Greases | 811198: All Other Automotive Repair and Maintenance | $10m revenue | 3,637 | 3,596 | 4,007 | 17,686 | 10,639 | $815,674 | $2,626,931 |
| Aerosol Spray Cleaning/Degreasing; Lubricants and Greases | 811211: Electronic and Precision Equipment Repair and Maintenance | $34m revenue | 1,746 | 1,728 | 1,845 | 12,636 | 7,510 | $528,251 | $1,612,777 |
| Aerosol Spray Cleaning/Degreasing; Lubricants and Greases | 811212: Electronic and Precision Equipment Repair and Maintenance | $34m revenue | 5,068 | 5,014 | 5,454 | 33,730 | 22,877 | $1,629,120 | $4,953,788 |
| Aerosol Spray Cleaning/Degreasing; Lubricants and Greases | 811213: Electronic and Precision Equipment Repair and Maintenance | $34m revenue | 1,738 | 1,712 | 2,036 | 17,740 | 9,574 | $1,274,725 | $6,678,850 |
| Aerosol Spray Cleaning/Degreasing; Lubricants and Greases | 811219: Electronic and Precision Equipment Repair and Maintenance | $34m revenue | 2,787 | 2,702 | 3,421 | 35,369 | 15,943 | $2,850,510 | $9,170,014 |
| Furniture Refinishing; Liquid Cleaners and Degreasers; Aerosol Spray Cleaning/Degreasing; Paint and Coating Removers (Pleasure Craft Building and Repairing); Paint and Coatings; Lubricants and Greases; Antispatter Welding Aerosol | 811310: Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance | $12.5m revenue | 19,986 | 19,238 | 21,814 | 200,268 | 101,827 | $13,252,720 | $43,412,686 |
| Aerosol Spray Cleaning/Degreasing; Paint and Coating Removers (Bathtub Refinishing); Lubricants and Greases | 811411: Home and Garden Equipment Repair and Maintenance | $9m revenue | 1,704 | 1,698 | 1,722 | 4,559 | 4,317 | $131,877 | $674,935 |
| Furniture Refinishing; Paint and Coating Removers (Bathtub Refinishing); Paint and Coating Removers (Automotive Repair and Refinishing) | 811412: Appliance Repair and Maintenance | $19m revenue | 4,399 | 4,388 | 4,579 | 18,757 | 15,117 | $851,759 | $4,066,313 |
| Furniture Refinishing; Glues, Sealants, Adhesives, and Caulks; Paint and Coating Removers (Bathtub Refinishing); Paint and Coating Removers (Art Restoration); Adhesive and Caulk Remover | 811420: Reupholstery and Furniture Repair | $9m revenue | 3,636 | 3,636 | 3,657 | 12,222 | 12,222 | $403,427 | $1,230,876 |
| Furniture Refinishing | 811430: Footwear and Leather Goods Repair | $9m revenue | 933 | 933 | 966 | 2,453 | 2,453 | $64,616 | $224,306 |
| Furniture Refinishing; Aerosol Spray Cleaning/Degreasing; Paint and Coating Removers (Art Restoration); Lubricants and Greases | 811490: Other Personal and Household Goods Repair and Maintenance | $9m revenue | 9,938 | 9,864 | 10,643 | 36,437 | 29,621 | $1,332,965 | $4,637,639 |
| Dry Cleaning and Spot Removers | 812310: Coin-Operated Laundries and Drycleaners | $13m revenue | 9,725 | 9,690 | 10,798 | 40,419 | 36,847 | $886,178 | $4,761,677 |
| Dry Cleaning and Spot Removers | 812320: Drycleaning and Laundry Services (except Coin-Operated) | $8m revenue | 18,087 | 17,953 | 20,643 | 131,543 | 113,492 | $2,958,493 | $8,751,014 |
| Paint and Coating Removers (Art Restoration) | 812921: Photofinishing Laboratories (except One-Hour) | $29.5m revenue | 415 | 412 | 427 | 5,419 | 5,419 | $317,687 | $1,742,112 |
| Paint and Coating Removers (Professional Contracting) | 812990: All Other Personal Services | $15m revenue | 15,356 | 15,313 | 15,874 | 59,871 | 52,500 | $3,164,043 | $10,629,593 |
| Sources: [U.S. Census Bureau 2021](#_ENREF_79); [U.S. Census Bureau 2022](#_ENREF_80); [BEA 2023](#_ENREF_71); [Dun & Bradstreet 2022](#_ENREF_17); [SBA 2023](#_ENREF_111) | | | | | | | | | |

# Products Formulated with Methylene Chloride

This chapter presents the results from EPA’s search to identify products that might contain methylene chloride and discusses some of the implications of the prohibition of methylene chloride use in these products. The search was conducted using the Consumer Product Information Database (CPID), at [www.whatsinproducts.com](http://www.whatsinproducts.com), retail websites that sell related products (*e.g.,* [www.grainger.com](http://www.grainger.com)), and the websites of the manufacturers with products that were identified from the CPID, retailer websites, and EPA risk evaluation support documents ([EPA 2017a](#_ENREF_90), [EPA 2017b](#_ENREF_91), [EPA 2017c](#_ENREF_92), [EPA 2017d](#_ENREF_93), [EPA 2017e](#_ENREF_94)).

EPA expects that the manufacturers who already have alternative products would respond to a regulation that prohibits or restricts methylene chloride use by discontinuing the methylene chloride product without replacing it with a new product line. Thus, businesses would not be expected to incur any direct compliance costs. Businesses may incur indirect costs through reduced sales, but these are likely to at least be partially offset by some customers shifting to another one of their products. Since any reduced sales they experience are likely to be a competitor’s gain, the net change in producer surplus across all producers is uncertain. Similarly, the net effects on upstream and downstream producers, distributors, and retailers are likely to be close to zero as purchasers shift to an alternative to the prohibited product.

By eliminating some of the choices that purchasers have available to them, there is likely to be a consumer surplus welfare loss that would result from requirements that restrict or limit these products. The specific value cannot be estimated without knowing the quantity of the prohibited product that is sold and the elasticity of demand for the specific product that would be prohibited. However, when a wide variety of close substitutes are available, the demand for a specific product is likely to be elastic (*i.e.,* a relatively small increase in price is likely to result in customers shifting demand to different products instead). Thus, although EPA is unable to quantify the consumer surplus loss that would result from an option prohibiting methylene chloride, the welfare loss is likely to be small, because products with similar prices and efficacy are widely available.

Table 4‑1 shows the companies and types of products containing methylene chloride by product type. Table 4‑2 presents the parent company names, NAICS, annual revenue, number of employees, small business threshold, small business status and the number of products formulated with methylene chloride for each product formulator.

| Table 4‑1: Types and Number of Products Containing Methylene Chloride, by Product Type | | | | |
| --- | --- | --- | --- | --- |
| Product Type | Parent Company Name | Product Name | % Methylene Chloride | Has Existing Methylene Chloride-Free Alternative |
| Liquid Degreaser | Berryman Products Inc | Berryman Professional Chem-Dip Carburetor Cleaner | 30-40 | Yes1 |
| NM Z Parent Inc | Zepresto | 30-50 | Yes |
| Formula 300 | 10-20 | Yes |
| Aerosol Degreaser | Berryman Products Inc | Berryman’s Brake Parts Cleaner | 60-70 | Yes |
| Blumenthal Holdings LLC | Carb Medic Carburetor Cleaner | 60-70 | Yes |
| Gunk Carburetor Parts Cleaner | 20-30 | Yes |
| NM Z Parent Inc. | AutoZone Carburetor Cleaner | 40-60 | Yes |
| American Industries Inc | Rapid Solv | 37-61 | Yes |
| Nu-Calgon Wholesaler Inc | Cal-Blast | 80-100 | Yes |
| Vapco Products, Inc. | Blowout | 60-100 | No |
| Quest Specialty | Carbon Off | 40-70 | Yes |
| Paint and Coating Removers | Benco Sales Inc | B17 | 55-65 | Yes |
| Canberra Corp | Husky 1229 Vandalism Mark & Stain Remover | 40-60 | No |
| Columbia Coatings | Rap'Strip Liquid | 75-95 | No |
| Packaging Service Co Inc | Crown Tuff-Strip Semi-Paste Remover | 65-75 | Yes |
| Quest Specialty | Ruthless | 60-100 | No |
| Barr Brands Intl | Jasco Premium Paint & Epoxy Remover | 60-80 | Yes |
| Adhesive and Caulk Remover | Savogran | Superstrip | 80-85 | Yes |
| Magic Bullet Products Ltd | Strong Adhesive & Residue Remover | >50 | No |
| Lithographic Printing Cleaner | Day International, Inc. | V-1106 Rejuvenator Plus | 45 | Yes |
| Blanket & Roller Wash V-133 | 15 | Yes |
| Duplicator Wash | 23.3 | Yes |
| Varn Swell | 88.5 | Yes |
| Dry Cleaning and Spot Remover | Apparel Sourcing Group Inc | Pull Out 2 | 21-34 | Yes |
| Glues, Sealants, Adhesives, and Caulks | Illinois Tool Works Inc | PX 101MA Copper Gasket Sealant | 10-30 | Yes |
| 3M Co | SS HM Adhesive | 40-50 | Yes |
| SS HMS Adhesive | 40-70 | Yes |
| SS HPLV-Plus | 40-70 | Yes |
| Foam Fast 74NF Cylinder Spray Adhesive | 40-70 | Yes |
| Hi-Strength Non-Flammable 98NF Cylinder Spray Adhesive | 60-85 | Yes |
| NS925 Adhesive | 40-50 | Yes |
| Non-Flammable NS925 Adhesive | 40-70 | Yes |
| PB920-Plus | 40-70 | Yes |
| PB924 High Temperature High Strength Pressure Sensitive Adhesive | 40-50 | Yes |
| PB924 Non-Flammable High Temperature High Strength Pressure Sensitive Adhesive | 40-70 | Yes |
| PB925 High Temperature High Strength Pressure Sensitive Adhesive | 40-50 | Yes |
| PB925 Non-Flammable High Temperature High Strength Pressure Sensitive Adhesive | 40-70 | Yes |
| PB970 High Heat Resistant Spray Adhesive | 70-90 | Yes |
| PB975 High Solids Spray Grade Adhesive | 60-90 | Yes |
| Camie-Campbell Inc | 313B Upholstery Adhesive | 80-90 | Yes |
| Design Polymerics | Closed Cell Foam Spray Adhesive | 40-50 | Yes |
| Permira Advisers LLC | GP1-40BL Adhesive | 45-55 | Yes |
| Ductmate Industries Inc | QuickStick | 40-70 | Yes |
| QuickStick High Strength Spray Adhesive | 40-70 | Yes |
| Elgen Manufacturing Inc. | AE-77 | 40-70 | Yes |
| Spray on Liner Adhesive | 40-70 | Yes |
| Hylomar LLC | Universal Blue/Aerograde PL32 | 25-65 | Yes |
| Illinois Tool Works Inc | STA’-PUT 1535 Contact Adhesive | 55-75 | Yes |
| STA’-PUT S100 Contact Adhesive | 55-75 | Yes |
| STA’-PUT S120 Contact Adhesive | 75-90 | Yes |
| STA’-PUT S170 Contact Adhesive | 45-70 | Yes |
| STA’-PUT S200 Aerosol Adhesive | 45-70 | Yes |
| STA’-PUT SPH Aerosol Adhesive | 35-60 | Yes |
| STA’-PUT SPH Contact Adhesive | 65-80 | Yes |
| STA’-PUT SPHS Adhesive | 55-75 | Yes |
| STA’-PUT SPM Aerosol Adhesive | 45-70 | Yes |
| Parker-Hannifin Corp | Chemlok 8212 | 0.1-0.9 | Yes |
| Maple Leaf Sales II, Inc. | K-Grip 201 | 70-90 | Yes |
| K-Grip 203 | 70-90 | Yes |
| New Star Adhesive | ES30 Contact Adhesive | 40-50 | Yes |
| ES35 Contact Adhesive | 60-70 | Yes |
| ES130 Contact Adhesive | 80-100 | Yes |
| ES800 Contact Adhesive | 65-80 | Yes |
| Quin Global | A20 Plasticizer Resistant Crosslinking Contact Adhesive | 30-60 | Yes |
| A40N Non-Flammable Low Profile Contact Adhesive | 60-100 | Yes |
| F30N Non-Flammable Pressure Sensitive Foam & Fabric Adhesive | 60-100 | Yes |
| F70N Non-Flammable Aggressive Pressure Sensitive Adhesive | 60-100 | Yes |
| H20N Non-Flammable Duct Liner Adhesive | 60-100 | Yes |
| L10AA High Temp Contact Adhesive | 30-60 | Yes |
| L10N Non-Flammable High Temperature Contact Adhesive | 60-100 | Yes |
| L12-AA Aggressive High Profile Contact Adhesive | 30-60 | Yes |
| L71 Plasticizer Resistant Crosslinking Contact Adhesive | 30-60 | Yes |
| L72N | 30-60 | Yes |
| M10N Non-Flammable High Temperature Pressure Sensitive Adhesive | 60-100 | Yes |
| M80AA High Temperature Contact Adhesive | 30-60 | Yes |
| M80N | 60-100 | Yes |
| P300AA High Temperature General Purpose Contact Adhesive | 30-60 | Yes |
| P302 Non-Flammable High Temperature Contact Adhesive | 60-100 | Yes |
| P305 Non-Flammable Pressure Sensitive Adhesive | 30-60 | Yes |
| P309 Non-Flammable Pressure Sensitive Adhesive | 60-100 | Yes |
| P310AA Pressure Sensitive Adhesive | 30-60 | Yes |
| P311 Non-Flammable Pressure Sensitive Adhesive | 60-100 | Yes |
| P801 Plasticizer Resistant Crosslinking Contact Adhesive | 30-60 | Yes |
| P807 Snowflake Single-Sided Crosslinking Contact Adhesive | 30-60 | Yes |
| OWG Beteiligungs AG | UT-R20 Hardener | 60-85 | Yes |
| Royal Coatings and Specialty Polymers | Parabond M-363 Seam Sealer | 50-100 | Yes |
| Centerbridge Partners LP | SCIGRIP® 3 Low VOC Solvent Cement for Acrylic | 75-90 | Yes |
| SCIGRIP® 4 Solvent Cement for Acrylic | 30-60 | Yes |
| SCIGRIP® 16 Solvent Cement for Acrylic | 30-60 | Yes |
| Sullivan Supply Inc | Primetime Adhesive | 35 | Yes |
| EZ-Comb Adhesive | 35 | Yes |
| Tail Adhesive | Proprietary | Yes |
| Lubricants and Greases | MSC Industrial Direct Co Inc | Cutting Tool Coolant | 19.5 | Yes |
| K-Chem Inc | Grease Gun in a Can | 50-60 | Yes |
| CK Enterprises | Dry Moly | 52-88 | Yes |
| Delta Foremost Chemical Corp | ES Dry Moly Aerosol | Proprietary | Yes |
| Hi-Temp Anti-Seize Copper Base Aerosol | Proprietary | Yes |
| Mid-American Research | Patrol Dry-Moly Lubricant | 50-100 | Yes |
| Quest Specialty | Moly DSD Aerosol | 60-100 | Yes |
| MoliGuard | 60-100 | Yes |
| Camie-Campbell Inc | Dry Moly Lube | 50-100 | Yes |
| Cold Pipe Insulation | Quest Specialty | Surround Cold Pipe Insulation Spray | 30-60 | No |
| Anti-Spatter Welding Aerosol | CANTESCO | Heavy Duty Solvent-Based Anti-Spatter | 60-100 | Yes |
| Berwind Corp | Nozzle-Kleen® HD® | 90-100 | Yes |
| Nozzle-Kleen® #2® | 90-100 | Yes |
| Weld-Kleen® HD® | 80-90 | Yes |
| Bestwelds Solvent-Based Anti-Spatter Aerosol | 85-95 | Yes |
| Dynaflux Inc | 200 Heavy Duty Anti-Spatter Aerosol | Proprietary | Yes |
| Dynaweld Industrial Supplies PTY Limited | Bossweld Anti-Spatter Spray | 60 | Yes |
| Forney Industries Inc | Welder’s Anti-Spatter Spray, Silicone-Free | Proprietary | Yes |
| Lincoln Electric Holdings Inc | 1620 Anti-Spatter | 73-84 | Yes |
| Hot Max | Hot Max 23000 Anti-Spatter Spray, Silicone Free | 60-100 | No |
| K T Industries Inc | Heavy Duty Anti-Spatter Aerosol | Proprietary | No |
| Radnor | Solvent-Based Anti-Spatter Aerosol | 90 | Yes |
| Techniweld USA | Solvent-Based Anti-Spatter / Nozzle Shield | 90 | Yes |
| Welding Material Sales | Blue Demon Solvent-Based Anti-Spatter Aerosol | 90 | Yes |
| 1One alternative product contains the TSCA work plan chemical N-Methyl-2-Pyrollidone (NMP); another alternative product contains no TSCA work plan chemicals. | | | | |

| Table 4‑2: Small Business Determination for Product Formulators by Parent Company Name | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Parent Company Name | NAICS | Revenue | Employees | SBA Small Business Threshold | Small Business Status | Number of Products |
| 3M Co | 339112: Surgical And Medical Instrument Manufacturing | $34,229 m | 92,000 | 1,000 employees | Large | 18 |
| American Industries Inc | 424690: Other Chemical And Allied Products Merchant Wholes | $35 m | 4 | 175 employees | Small | 1 |
| Apparel Sourcing Group Inc | 423850: Service Establishment Equipment And Supplies Merch | $95 m | 18 | 125 employees | Small | 1 |
| Barr Brands Intl | 325510: Paint And Coating Manufacturing | $895 m | 520 | 1,000 employees | Small | 1 |
| Benco Sales Inc | 325510: Paint And Coating Manufacturing | $1 m | 16 | 1,000 employees | Small | 1 |
| Berryman Products Inc | 325180: Other Basic Inorganic Chemical Manufacturing | $41 m | 50 | 1,000 employees | Small | 2 |
| Berwind Corp | 523940: Portfolio Management And Investment Advice | $425 m | 3,501 | $47m revenue | Large | 4 |
| Blumenthal Holdings LLC | 325998: All Other Miscellaneous Chemical Product And Prepa | $790 m | 143 | 650 employees | Small | 2 |
| CK Enterprises | 423850: Service Establishment Equipment And Supplies Merch | $68 m | 85 | 125 employees | Small | 1 |
| Camie-Campbell Inc | 339999: All Other Miscellaneous Manufacturing | $2 m | 12 | 550 employees | Small | 1 |
| Canberra Corp | 325612: Polish And Other Sanitation Good Manufacturing | $127 m | 200 | 900 employees | Small | 1 |
| CANTESCO | - | - | - | - | - | 1 |
| Charles Paint Research Inc | 325510: Paint And Coating Manufacturing | $10 m | 10 | 1,000 employees | Small | 1 |
| Centerbridge Partners LP | 523910: Miscellaneous Intermediation | $25,000 m | 60,006 | $47m revenue | Large | 3 |
| Columbia Coatings | 332812: Metal Coating, Engraving (Except Jewelry And Silve | $16 m | 15 | 600 employees | Small | 1 |
| Day International, Inc. | 523150: Investment Banking And Securities Intermediation | - | - | - | Large | 4 |
| Delta Foremost Chemical Corp | 325611: Soap And Other Detergent Manufacturing | $17 m | 100 | 1,100 employees | Small | 2 |
| Design Polymerics | 325520: Adhesive Manufacturing | $8 m | 12 | 550 employees | Small | 1 |
| Ductmate Industries Inc | 339999: All Other Miscellaneous Manufacturing | $1 m | 29 | 550 employees | Small | 2 |
| Dynaflux Inc | 333992: Welding And Soldering Equipment Manufacturing | $35 m | 50 | 1,250 employees | Small | 1 |
| Dynaweld Industrial Supplies PTY Limited | 423830: Industrial Machinery and Equipment Merchant Wholesalers | $11 m | 30 | 100 employees | Small | 1 |
| Elgen Manufacturing Inc. | 332322: Sheet Metal Work Manufacturing | $130 m | 201 | 500 employees | Small | 2 |
| Forney Industries Inc | 423840: Industrial Supplies Merchant Wholesalers | $54 m | 130 | 125 employees | Large | 1 |
| Lincoln Electric Holdings Inc | 333992: Welding And Soldering Equipment Manufacturing | $3,761 m | 12,000 | 1,250 employees | Large | 1 |
| Hot Max | - | - | - | - | - | 1 |
| Hylomar LLC | 339940: Office Supplies (Except Paper) Manufacturing | $2 m | 10 | 750 employees | Small | 1 |
| Illinois Tool Works Inc | 333912: Air And Gas Compressor Manufacturing | $15,932 m | 46,000 | 1,000 employees | Large | 10 |
| K T Industries Inc | 423840: Industrial Supplies Merchant Wholesalers | $3 m | 4 | 125 employees | Small | 1 |
| K-Chem Inc | 424690: Other Chemical And Allied Products Merchant Wholes | $8 m | 5 | 175 employees | Small | 1 |
| Magic Bullet Products Ltd | 332812: Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers. | $0.4 m | 3 | 600 employees | Small | 1 |
| Maple Leaf Sales II, Inc. | 424690: Other Chemical and Allied Products Merchant Wholesalers | $1 m | 3 | 175 employees | Small | 3 |
| Mid-American Research | 325612: Polish And Other Sanitation Good Manufacturing | $17 m | 24 | 900 employees | Small | 1 |
| MSC Industrial Direct Co Inc | 423830: Industrial Machinery And Equipment Merchant Wholes | $3,692 m | 6,880 | 100 employees | Large | 1 |
| New Star Adhesive | 424690: Other Chemical And Allied Products Merchant Wholes | $18 m | 10 | 175 employees | Small | 4 |
| NM Z Parent Inc. | 325320: Pesticide Other Agricultural Chemical Manufacturing | $980 m | 2,300 | 1,150 employees | Large | 3 |
| Nu-Calgon Wholesaler Inc | 333415: Air-Conditioning And Warm Air Heating Equipment An | $13 m | 60 | 1,250 employees | Small | 1 |
| OWG Beteiligungs AG | 423840: Industrial Supplies Merchant Wholesalers | - | 7,781 | 125 employees | Large | 1 |
| Packaging Service Co Inc | 561910: Packaging And Labeling Services | $ m | 6 | $19.5m revenue | Small | 1 |
| Parker-Hannifin Corp | 333998: All Other Miscellaneous General Purpose Machinery | $19,065 m | 62,730 | 700 employees | Large | 1 |
| Permira Advisers LLC | 523910: Miscellaneous Intermediation | $3,532 m | 8,139 | $47m revenue | Large | 1 |
| Quest Specialty | 325611: Soap And Other Detergent Manufacturing | $56 m | 60 | 1,100 employees | Small | 3 |
| Quin Global | 325520: Adhesive Manufacturing | $12 m | 20 | 550 employees | Small | 21 |
| Radnor | - | - | - | - | - | 1 |
| Royal Coatings and Specialty Polymers | 424690: Other Chemical and Allied Products Merchant Wholesalers | $5 m | 10 | 175 employees | Small | 1 |
| Savogran Co | 325510: Paint And Coating Manufacturing | $18 m | 45 | 1,000 employees | Small | 1 |
| Sullivan Supply Inc | 424910: Farm Supplies Merchant Wholesalers | $3 m | 2 | 200 employees | Small | 3 |
| Techniweld USA | 423840: Industrial Supplies Merchant Wholesalers | $9 m | 10 | 125 employees | Small | 1 |
| Vapco Products, Inc. | 325998: All Other Miscellaneous Chemical Product and Preparation Manufacturing | $3 m | 12 | 650 employees | Small | 1 |
| Welding Material Sales | 423840: Industrial Supplies Merchant Wholesalers | $56 m | 45 | 125 employees | Small | 1 |

# Use and Alternatives Analysis

This Chapter discusses the uses and alternatives for methylene chloride. Section 5.1 presents the overview of the use and alternatives analysis presented in this Chapter. The remainder of the chapter is organized according to the product categories considered in the analysis and Table 5‑1 presents a map between the use categories and the sections of the chapter where they are discussed. In addition, the analysis addresses the TSCA Section 6(c)(2) requirement for EPA to consider alternatives. This chapter focuses on the technological and economic feasibility of potential methylene chloride alternatives. There is a separate analysis which evaluates whether the alternatives are beneficial to human health or the environment relative to methylene chloride ([EPA 2022b](#_ENREF_108)).

| Table 5‑1: Use Categories Considered in the Economic Analysis Mapped to the Conditions of Use (COUs) Defined in the Risk Evaluation | |
| --- | --- |
| Use Category | Alternatives Analysis |
| 1. Cellulose Triacetate Film Production | 1. Section 5.3, Cellulose Triacetate Film Production |
| 1. Vapor Degreasing | 1. Section 5.4, Vapor Degreasing |
| 1. Liquid Cleaners and Degreasers 2. Aerosol Spray Cleaning/Degreasing | 1. Section 5.5, Liquid and Aerosol Cleaners and Degreasers: AC Coil Cleaners 2. Section 5.6, Liquid and Aerosol Cleaners and Degreasers: Brake Cleaning Products 3. Section 5.7, Liquid and Aerosol Cleaners and Degreasers: Carburetor Cleaner |
| 1. Paint and Coating Removers | 1. Section 5.8, Paint and Coating Removers |
| 1. Adhesive and Caulk Remover | 1. Section 5.9, Adhesive and Caulk Remover |
| 1. Lithographic Printing Cleaner | 1. Section 5.10, Lithographic Printing Cleaner |
| 1. Dry Cleaning and Spot Removers | 1. Section 5.11, Dry Cleaning and Spot Removers |
| 1. Glues, Sealants, Adhesives, and Caulks | 1. Section 5.12, Glues, Sealants, Adhesives, and Caulks: Sealants 2. Section 5.13, Glues, Sealants, Adhesives, and Caulks: Adhesives |
| 1. Lubricants and Greases | 1. Section 5.14, Lubricants and Greases |
| 1. Cold Pipe Insulation | 1. Section 5.16, Cold Pipe Insulation |
| 1. Anti-spatter Welding Aerosol | 1. Section 5.17, Anti-spatter Welding Aerosol |
| 1. Paint and Coatings | 1. Not applicable, see section 5.2, Use Categories and COUs Not Considered in the Use and Alternatives Analysis. |
| 1. Distribution in commerce | 1. Not considered/applicable, see section 5.2, Use Categories and COUs Not Considered in the Use and Alternatives Analysis. |
| 1. Manufacturing | 1. Not considered/applicable, see section 5.2, Use Categories and COUs Not Considered in the Use and Alternatives Analysis. |
| 1. Import/Repackage | 1. Not considered/applicable, see section 5.2, Use Categories and COUs Not Considered in the Use and Alternatives Analysis. |
| 1. Processing as a Reactant | 1. Not applicable, see section 5.2, Use Categories and COUs Not Considered in the Use and Alternatives Analysis. |
| 1. Incorporation Into Formulation, Mixture, or Reaction Product | 1. Not considered/applicable, see section 5.2, Use Categories and COUs Not Considered in the Use and Alternatives Analysis. |
| 1. Waste Handling, Disposal, Treatment, and Recycling | 1. Not considered/applicable, see section 5.2, Use Categories and COUs Not Considered in the Use and Alternatives Analysis. |
| 1. Laboratory Use | 1. Not considered/applicable, see section 5.2, Use Categories and COUs Not Considered in the Use and Alternatives Analysis. |
| 1. Industrial and Commercial Use as a Processing Aid | 1. Not considered/applicable, see section 5.2, Use Categories and COUs Not Considered in the Use and Alternatives Analysis. |
| 1. Plastic and Rubber Manufacturing | 1. Not considered/applicable, see section 5.2, Use Categories and COUs Not Considered in the Use and Alternatives Analysis. |
| 1. Toys, Playground, and Supporting Equipment | 1. Not applicable, see section 5.2, Use Categories and COUs Not Considered in the Use and Alternatives Analysis. |
| 1. Uses believed to be inactive or fully overlap with other conditions of use | 1. Industrial and commercial use in automotive care products (functional fluids for air conditioners) 2 |
| 1. Industrial and commercial use as propellant and blowing agent3 |
| 1. Consumer use in brush cleaners for paints and coatings2 |
| 1. Consumer use in automotive care products (functional fluids for air conditioners) 2 |
| 1. Industrial and commercial use in finishing products for fabric, textiles and leather4 |
| 1. Industrial and commercial use in apparel and footwear care products4 |
| 1. Industrial and commercial use for electrical equipment, appliance, and component manufacturing4 |
| 1. Industrial and commercial use for oil and gas drilling, extraction, and support activities4 |
| 1. Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner1 |
| 1. Consumer use in carbon removers and other brush cleaners1 |
| 1EPA believes that brush cleaning is an inactive use, wood floor cleaning is also believed to be an inactive use (although paint removers may be used for this purpose). Carbon removers are an active use and included under aerosol spray cleaning/degreasing. Note that these COUs are listed twice since they include both active and inactive uses.  2 Based on market research, EPA believes these are inactive uses.  3 Based on stakeholder outreach with industry, EPA believes this is an inactive use.  4 This COU is defined according to the sector using methylene chloride. EPA believes that there are no active uses by this sector or that the uses by this sector overlap with one or more of the COUs that are defined according to how the methylene chloride is being used. | |

## Overview of Use and Alternatives Analysis Approach

Products discussed in this chapter were identified through a series of online searches, or through an inventory of products described in Chapter 4. The searches encompassed products available for purchase either by large and small businesses or by individual consumers. Certain product categories are relevant only for industrial or commercial use, while others are relevant for both.

This review provides a representative, but not exhaustive, listing of commercially available products for each product category evaluated. Therefore, the calculated market share percentages, price ranges, and conclusions about efficacy factors would likely change if more products were included in the review of various product categories. These changes would be most significant for broad product categories with numerous sub applications such adhesives, caulks, and conventional press washes. The products included in the analysis were the products with the largest number of online customer reviews for products. This measure was used as a proxy for quantity of use. Products with relatively few or no online customer reviews were omitted from the analysis if several products with a higher number of customer reviews were available. Products with no online customer reviews were sometimes included, especially if there were limited products available with customer reviews within a product category.

For each product, one Safety Data Sheet (SDS) was obtained and was used as the source of information for ingredients, ingredient concentrations, VOC content, evaporation rate, flash point, other fire safety information, and substrate compatibility in some cases. It is worth noting that SDSs sometimes contain inconsistencies or inaccuracies, but additional data sources for these data points were not reviewed, except where specifically noted. In addition, SDSs sometimes provide a range of ingredient concentrations, rather than providing an exact formulation. The search for SDSs was not exhaustive for each product; therefore, additional SDS versions may exist for the same products.

### Substitute Chemicals

For any effort to eliminate or replace methylene chloride, several approaches may be possible. Options include drop-in substitution; reformulation; process change; upstream changes; or elimination of the activity requiring the use of the chemical. For example, for the use of methylene chloride in degreasing applications, an example of a drop-in substitution would be adoption of an alternative organic solvent that does not require any change in equipment or processes. An example of a process change would be a shift from an aerosol spray to an aqueous cleaning system using different equipment. An example of an upstream change would be a change in the use of oils or greases, shifting to a material that is easier to remove from parts. Similarly, a degreasing step can sometimes be eliminated entirely by changing oils or greases upstream.

Where applicable, this analysis examines drop-in solvent substitutes. In some cases, the analysis includes products that would be associated with a process change. It is important to note that in many cases, additional process change options are available to both businesses and consumers. Other TSCA priority chemicals were not considered as viable substitutes.

### Analysis Sections for Each Product Category

The following analysis sections were included for each product category. For ease of reviewing the analysis, the rows are shaded orange in all tables for products containing methylene chloride and are shaded grey for products containing another one of the first 10 TSCA work plan chemicals. All rows with products containing other alternatives are not shaded.

#### Description

A brief description of the product used in the product category is provided.

#### Solvent Ingredients

The solvent ingredients are provided for each of the products reviewed. The solvent names and concentrations were obtained from product Safety Data Sheets (SDSs). In some cases, it may not be clear if the primary function of a particular ingredient is as a solvent, or an ingredient may serve additional functions, such as acting as an emulsifier. If the listed ingredient appeared to have a solvency role, it was included.

#### Chemical Ranking/ Market Share

A chemical ranking procedure was developed as a proxy for market share percentage of the chemicals used in products. This procedure provides a coarse estimate of 1) market share percentage of chemicals used within the current marketplace, and 2) the anticipated market share percentage of alternative chemicals in replacement products if methylene chloride were restricted for a certain product category. This procedure is further described in Appendix A. Note that the estimated "market share" refers to the amount of solvent/chemicals used in a particular product category, not the number of products based on a particular chemistry.

For several product categories, there were many more alternative products commercially available than products with methylene chloride. When including only products with higher number of customer reviews, the number of alternative products excluded from the analysis was greater than for methylene chloride products. Consequently, the current market share percentage may be overstated for the methylene chloride products in these product categories. However, this would have no impact on the estimated market share percentage for replacement products after methylene chloride restrictions.

Water is often not included in product SDSs. For this evaluation, water was included as an ingredient only if it was listed in the SDS or the product description specifically states that the product is water based. Otherwise, it was not assumed that water is an ingredient. It is likely that some products may have water as an ingredient and the product description may not state water based. Therefore, the approximate market share percentages calculated with this procedure may understate the actual representation of water used in products.

#### Volatile Organic Compounds (VOC) Content

This section provides VOC regulatory limits established by the U.S. EPA at the federal level, the South Coast Air Quality Management District (SCAQMD) at the regional level, and the Ozone Transport Commission (OTC) at the state level. The regulatory definition of VOCs used by the U.S. EPA is as follows: "Any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participate in atmospheric photochemical reactions" ([Tucker 2001](#_ENREF_69)). OTC is a multi-state organization that was created under the Clean Air Act. OTC is responsible for advising the U.S. EPA on transport issues and for developing and implementing regional solutions to the ground-level ozone problem in the Northeast and Mid-Atlantic regions ([OTC 2020](#_ENREF_56)). SCAQMD is the regulatory agency responsible for improving air quality for large areas of Los Angeles, Orange County, Riverside and San Bernardino counties in the state of California ([SCAQMD 2021](#_ENREF_64)). In addition to this regulatory information, the VOC information available in product SDSs is provided for each of the products reviewed. In some cases, VOC information was absent from the SDS but was present in a technical data sheet for the same product.

Methylene chloride and perchloroethylene are VOC exempt chemicals[[7]](#footnote-9), while 1-bromopropane, NMP, and trichloroethylene are not VOC exempt chemicals. Commonly used solvents in chemical product formulations that are VOC exempt include water, acetone, dimethyl carbonate, methyl acetate, parachlorobenzotrifluoride, propylene carbonate, and tert butyl acetate.

#### Fire Safety

The products reviewed were mainly composed of liquid solvents. "Flash point" is defined by U.S. Occupational, Safety and Health Administration (OSHA) and the U.S. Department of Transportation in the U.S. Code of Federal Regulations as: "The minimum temperature at which a liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid" ([OSHA 2009](#_ENREF_46); [U.S. Department of Transportation 2009](#_ENREF_81)). Under the Federal Hazardous Substances Act label requirements, the Consumer Product Safety Commission (CPSC) classifies a liquid with a flash point less than 20 °F as "Extremely Flammable"; greater than 20 °F and less than 100 °F as "Flammable"; and 100 °F to 150 °F as "Combustible." 16 CFR 1500.3(c)(6). Products with flash points greater than 150 °F are considered non-flammable. There are other definitions for flammable and combustible liquids. For example, OSHA defines a flammable liquid as any liquid having a vapor pressure not exceeding 40 pounds per square inch (absolute) at 100 ºF (37.8 ºC) and having a flashpoint at or below 199.4 ºF ([OSHA 2012](#_ENREF_47)). For the purposes of this analysis, EPA used the flash points found in product SDSs or technical data sheets, and translated those to ratings based on CPSC flammability classifications.

The primary way to mitigate fire hazard for products containing organic solvents is to utilize solvents with higher flash points so that the overall product has a flash point that would be considered either combustible or non-flammable. In some cases, there is also the option to incorporate evaporation barrier additives that diminish the evaporation rate of the solvents. Paint and coating removal products often contain evaporation barriers, as the objective is to keep the product from evaporating to extend contact time. No evidence was found that evaporation barrier additives are used for the other product categories reviewed.

Flash points found in product SDSs or technical data sheets are provided for each of the products reviewed. Note that a flammability rating given on an SDS may be based on a different system than the CPSC ratings used in this analysis. For example, the SDS may list a product as combustible, while under the CPSC system it is non-flammable.

#### Pricing and Customer Reviews

Pricing and customer review information obtained from publicly available websites are provided. This includes product prices, the number of customer reviews, and the average rating level for each of the products reviewed. It is important to note that prices can change over time, and are affected by a range of factors, including demand, availability of raw materials, and economies of scale, among other factors. In addition, products may be sold as concentrates or ready to use. Price comparisons assume that a similar amount of product would be used compared with the methylene chloride product for any given application. Thus, they do not account for differences in effectiveness between products that effects the amount of product needed per use.

#### Conclusion

The conclusion to each section summarizes findings and assesses whether any efficacy elements (*e.g.*, VOC and fire safety), or cost barriers exist to using the alternative products as replacements for products containing methylene chloride.

#### Additional Efficacy Factors

For certain product categories (*e.g.*, brake cleaners), additional efficacy factors were also assessed. Examples include removal time, no damage to substrate material, and irritating odor. For removal time, if removal time test results were not available, then Hansen Solubility Parameter data was used as a surrogate. Further information about the Hansen Solubility Parameters theory and application can be found in Appendix B. These additional efficacy factors were included only for applicable product categories.

## Use Categories and COUs Not Considered in the Use and Alternatives Analysis

The use categories and the COUs not considered in the use and alternatives analysis and the reasons they excluded are presented in Table 5‑2 below.

| Table 5‑2: Conditions of use from the methylene chloride TSCA risk evaluation which are not analyzed further in this use and alternatives analysis | | |
| --- | --- | --- |
| Use Category | Conditions of Use (COUs) | Explanation |
| Manufacturing | * Manufacturing (Domestic Manufacture) | Domestic manufacturing and import are alternatives for one another. The neat chemical must either be made domestically or imported into the United States. Chemical alternatives to methylene chloride are accounted for in later stages of the chemical’s life cycle based on specific uses. |
| Import/Repackage | * Manufacturing: Import |
| * Processing: repackaging | The alternative for domestic repackaging is importing a repackaged product. Therefore, chemical alternatives for this COU are not identified. |
| Processing as a Reactant | * Processing: as a reactant | EPA has focused their assessment on alternative chemical ingredients performing the same or similar functions as methylene chloride in products for consumer or commercial/industrial use. In this COU, EPA did not find it practicable to consider whether there are alternative processes that directly replace methylene chloride with an alternative chemical or represent larger changes in multiple process steps in the production of a given chemical, due to the complexity of the analysis. The lack of known alternatives for this COU, for example processing as a reactant in the manufacturing of HFC-132, is accounted for in the development of the regulatory options. |
| Incorporation into Formulation, Mixture, or Reaction Product | * Processing: incorporation into a formulation, mixture, or reaction products * Industrial and commercial use as solvent that becomes part of a formulation or mixture | The alternatives are the processing or industrial/commercial use of a solvent to make products that do not contain methylene chloride. Therefore, chemical alternatives to methylene chloride are accounted for in later stages of the chemical’s life cycle. |
| Waste Handling, Disposal, Treatment, and Recycling | * Processing: recycling * Disposal | There are no alternatives to recycling and disposal in terms of products or alternative methods. |
| Laboratory Use | * Industrial and commercial use as a laboratory chemical | Alternatives were not considered because EPA is not prohibiting or restricting uses in a manner substantially preventing activities in this COU. |
| Industrial and Commercial Use as a Processing Aid | * Industrial and commercial use as a processing aid | EPA has focused their assessment on alternative chemical ingredients performing the same or similar functions as methylene chloride in products for consumer or commercial/industrial use. In this COU, EPA did not find it practicable to consider whether there are alternative processes that directly replace methylene chloride with an alternative chemical or represent larger changes in multiple process steps in the production of a given chemical, due to the complexity of the analysis. |
| Finishing Products for Fabric, Textiles, and Leather | * Industrial and commercial use in finishing products for fabric, textiles, and leather * Industrial and commercial use in apparel and footwear care products | There is evidence that methylene chloride has historically been used in select products in this category. Based on market research, EPA was unable to find reasonably available information in support of the ongoing use of methylene chloride for this COU. Therefore, it is not practicable to compare alternative products for this COU, as there are not products containing methylene chlorides on which to base the comparison of benefits for human health and the environment. |
| Industrial and Commercial Use for Electrical Equipment, Appliance, and Component Manufacturing | * Industrial and commercial use for electrical equipment, appliance, and component manufacturing | There is evidence that methylene chloride has historically been used in select products in this category. Based on market research, EPA was unable to find reasonably available information in support of the ongoing use of methylene chloride for this use category (other than uses that fall under other conditions of use). |
| Industrial and Commercial Use for Oil and Gas Drilling, Extraction, and Support Activities | * Industrial and commercial use for oil and gas drilling, extraction, and support activities | There is evidence that methylene chloride has historically been used in select products in this category. Based on market research, EPA was unable to find reasonably available information in support of the ongoing use of methylene chloride for this use category (other than uses that fall under other conditions of use). |
| Industrial and Commercial Use as a Propellant and Blowing Agent | * Industrial and commercial use as a propellant and blowing agent | There is evidence that methylene chloride has historically been used in select products in this category. Based on stakeholder outreach with industry, EPA was unable to find reasonably available information in support of the ongoing use of methylene chloride for this COU. |
| Functional Fluids | * Consumer use in automotive care products (functional fluids for air conditioners) * Industrial and commercial use in automotive care products (functional fluids for air conditioners) | There is evidence that methylene chloride has historically been used in select products in this category. Based on market research, EPA was unable to find reasonably available information in support of the ongoing use of methylene chloride for this use category. |
| Carbon Remover, Wood Floor Cleaner, and Brush Cleaner | * Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner * Consumer use in brush cleaners for paints and coatings | There is evidence that methylene chloride has historically been used in select products in this category. Based on market research, EPA was unable to find reasonably available information in support of the ongoing use of methylene chloride for this use category (other than uses that fall under other conditions of use). |
| Paint and Coatings | * Industrial and commercial use in paints and coatings | There is evidence that methylene chloride has historically been used in select products in this category. Based on market research, EPA was unable to find current products containing methylene chloride but some public comments indicate there may be some propriety industrial use in paints and coatings. EPA assumes that there are economically feasible alternatives to methylene chloride for this COU, but was unable to consider, to the extent practicable based on reasonably available information, whether these alternatives benefit health or the environment compared to this COU for methylene chloride. |
| Toys, Playground, and Supporting Equipment | * Industrial and commercial use in toys, playground, and sporting equipment | There is evidence that methylene chloride has historically been used in select products in this category. Based on stakeholder outreach with industry, EPA was unable to find reasonably available information in support of the ongoing use of methylene chloride for this COU. |

## Cellulose Triacetate Film Production

Cellulose triacetate is used to produce both fibers and films, and methylene chloride has been used in both processes. Once dissolved in methylene chloride, cellulose triacetate can be dry-spun into fibers, which have been used in textiles for clothing. A proposed OSHA rule from 1991 states that methylene chloride is a good solvent for dry spinning the fiber ([OSHA 1a991](#_ENREF_44)). However, the proposed rule lists several solvents that can be used in place of methylene chloride (chloroform, formic acid, glacial acetic acid, dioxan, and cresol) and also describes methods for cellulose triacetate fiber production that do not require methylene chloride (such as a non-solvent process and a wet spinning process). The proposed rule noted that a number of manufacturers were producing cellulose triacetate fibers without the use of methylene chloride, indicating that at least some alternatives were technologically and economically feasible.

## Vapor Degreasing

Methylene chloride is rarely used in vapor degreasing and vapor degreasing machines are no longer designed to be used with methylene chloride. Therefore, it is anticipated that the small number of remaining facilities that use methylene chloride for vapor degreasing will transition to technologically and economically feasible alternative cleaning methods. The methods may include vapor degreasing with aqueous cleaners or another non-water alternative such as hydrocarbon solvents, oxygenated solvents, terpene-based cleaners, parachlorobenzotrifluoride, volatile methyl siloxanes, or soy-based cleaners (IRTA [2016b](#_ENREF_31); [2016a](#_ENREF_30)). Three solvents commonly used for vapor degreasing are also included in the first 10 TSCA work plan chemicals: trichloroethylene, perchloroethylene, and 1-bromopropane. The risk evaluations for these three chemicals all found an unreasonable risk under TSCA for their use in vapor degreasing. Given the regulatory uncertainty while EPA considers risk management options for these chemicals, this analysis assumes that these chemicals would not be adopted as alternative open-top vapor degreasing solvents for methylene chloride while this regulatory uncertainty exists. Since the proposed perchloroethylene rule allows for its continued use in airless vapor degreasers and EPA believes that the emissions below the ECEL under the proposed rule are achievable, EPA believes that the use of perchloroethylene in an airless degreaser may be a popular choice as an alternative to methylene chloride vapor degreasing.

EPA consulted with critical cleaning experts Barbara Kanegsberg and Ed Kanegsberg of BFK Solutions about alternatives to methylene chloride in vapor degreasing. BFK Solutions helps manufacturers develop and/or optimize their cleaning processes. According to these experts, the alternatives that would be technologically and economically feasible would primarily depend on:

* the soils being removed;
* the level of cleanliness required;
* the characteristics of the components being cleaned; and
* the volume of components being cleaned.

Based on research, EPA expects that current users of methylene chloride may need to test multiple different cleaning processes before identifying a successful process, and that some users may transition from using methylene chloride in vapor degreasing to more than one alternative cleaning chemical/method.

The critical cleaning consultants considered alternatives to the use of methylene chloride in three sizes of degreasers used in the four cleaning categories. These are listed in the first two columns of Table 5‑3. The twelve primary cleaning methods are presented in the last column in Table 5‑3.

For this analysis, degreasers are defined as small, medium or large based on the cleaning chamber tank size. Dimensions for the size categories are: small–12 in. x 12 in. x 10 in.; medium–36 in. x 36 in. x 22 in.; large–60 in. x 42 in. x 36 in..

The critical cleaning experts defined four “cleaning categories” that would need different processes and cleaning requirements for switching to an alternative cleaning method from vapor degreasing with methylene chloride. These terms are defined relative to the expected end-use of the product and consequences of inadequate or inappropriate cleaning:

* **General Cleaning** is defined as having relatively low process development and low cost of process verification. Primary costs will include equipment and performance testing.
* **High Precision Cleaning** covers the cleaning of high value parts where very small residue is acceptable, at best. Significant process development is needed; customer or other regulatory performance standards may be the driving force. Primary costs will include evaluation, initial and on-going performance testing and capital costs.
* **Safety Critical Cleaning** includes product processes where performance failure is not an acceptable option, because failure poses dire hazards for patient, public safety, or national security and/or because the cost of failure would be prohibitively high (e.g., space flight). This category will have higher costs for process verification and validation and may also cover situations with very high-cost consequences of failure. Primary costs will include evaluation, initial performance testing, cleanliness validation/verification, and capital costs.
* **Start-up/R&D** **Critical Cleaning** covers the development process of new high precision or high value products prior to production; these would typically not require large degreasers and would need adaptable cleaning systems and perhaps multiple cleaning systems.

In addition to the list of primary cleaning methods included in Table 5‑3, there are other cleaning methods such as carbon dioxide, laser, and plasma that were not included because they are unlikely to be a primary replacement for a baseline method. They may be used as supplemental methods in order to achieve required cleanliness specifications. However, each method that is used will incur equipment and process development costs.

Table 5‑4 presents the descriptions of the alternative cleaning methods that would be the most likely to be economically and technically feasible.

| Table 5‑3: Sizes, Cleaning Categories, and Cleaning Methods Considered in the Vapor Degreasing Alternatives Analysis | | | | |
| --- | --- | --- | --- | --- |
| Size |  | Cleaning Category |  | Cleaning Method |
| Small |  | General |  | Airless Degreaser with PCE |
| Medium |  | High Precision |  | Convert OTVD to use Flashpoint inerted t-DCE |
| Large |  | Safety Critical |  | Replace with OTVD using FlashPoint inerted t-DCE |
|  | | Start-Up/R&D |  | Solstice system (trans-1-chloro-3,3,3,trifluoropropene) |
|  | |  |  | OTVD for Low boiling point (<100C) Alcohol or other flammable |
|  | |  |  | OTVD for Very low flashpoint (<0C) solvent |
|  | |  |  | Airless Degreaser for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols |
|  | |  |  | Co-Solvent, Bi-Solvent |
|  | |  |  | High boiling, non-vacuum, non-rinse |
|  | |  |  | Semi-Aqueous |
|  | |  |  | Aqueous Cleaning |
|  | |  |  | Hybrid system (example: Inventec, HEMO) |

| Table 5‑4: Alternative Cleaning Methods and their Definitions | |
| --- | --- |
| Cleaning Method | Definition |
| Airless Degreaser with PCE | An airless degreaser (sometimes referred to as an airless/airtight cleaning system) is equipment for which there is never an atmospheric air-solvent interface. Solvent does not enter the working chamber until the product to be cleaned has been placed in the chamber, the chamber has been sealed and air has been evacuated, usually to a level of one torr or less. Cleaning then can occur, usually by computer control, either by immersion (with or without ultrasonics), spray, or vapor degreasing. As with aqueous cleaning, solvent immersion cleaning could also include cyclic nucleation or cyclic cavitation, where the pressure is changed to provide boiling cycles. Following cleaning and rinsing cycles, the solvent is pumped back into sealed reservoirs, and the chamber is again pumped to a vacuum (sometimes through a carbon filter to capture residual traces of solvent vapors), thus providing vacuum drying. A closed-loop degreaser is not the same as an airless degreaser. While an OTVD that recirculates/redistills/reuses the solvent may be described as “closed loop”, such systems have not been demonstrated to match the low level of solvent loss achieved with an airless system. |
| Convert OTVD to use Flashpoint inerted t-DCE | An OTVD uses heated solvent in the liquid and/or vapor phase. For these cleaning methods, flashpoint inerted trans-dichloroethylene (trans-DCE) is the solvent. An OTVD may or may not have a cover. It may be characterized by the equipment supplier using terms like “well-sealed” or having “minimal solvent emissions.” Since flashpoint inerted trans DCE blends are more expensive, it may make sense for users to replace their OTVD if their existing machine is an older, more emissive model. Trans-DCE is currently undergoing Risk Evaluation by TSCA. The fluorinated inerting agents are also under scrutiny by the U.S. EPA and other regulators because of concerns about PFAS. |
| Replace with OTVD using Flashpoint inerted t-DCE |
| Solstice® system (trans-1-chloro-3,3,3,trifluoropropene) | An OTVD uses heated solvent in the liquid and/or vapor phase. For these cleaning methods, trans-1-chloro-3,3,3,trifluoropropene is the solvent. An OTVD may or may not have a cover. Because Solstice® has a low boiling point, the specifically designed OTVD may be characterized by the equipment supplier using terms like “well-sealed” or having “minimal solvent emissions.” Since trans-1-chloro-3,3,3,trifluoropropene blends are volatile and more expensive, it is very unlikely to be used as a “drop-in” in OTVDs currently in use for chlorinated or brominated solvents. |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | These systems are vapor degreasers where engineering controls have been employed to eliminate ignition and oxidation sources in order to ensure that flammable liquids can be used. They are certified to meet fire protection standards. Examples of low flashpoint solvents include simple alcohols like methanol, ethanol, and propanol. An azeotrope of cyclohexane with isopropanol has also been used. The most common very low flashpoint solvent is acetone. It should be noted that, with the exception of acetone, these other solvents are considered to be VOCs, and have restrictions in areas of poor air quality. |
| OTVD for Very low flashpoint (<0C) solvent |
| Airless Degreaser for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | These are systems containing combustible (flashpoint > 37.8C) solvents, with boiling points greater than 100C. The solvents in current use are either medium chain (~10-12 carbons) iso-paraffins or those that are called “modified alcohols”, such as iso-propanol connected to a butane (4-carbon) chain. Because the primary concern is reducing flammability concerns rather than toxic exposure, these systems are likely to be the same as airless degreasers, but need not be designed to completely eliminate the emissions to the degree required from chlorinated and brominated solvents. |
| Co-Solvent, Bi-Solvent | These are systems that use two organic solvents. For the purposes of this analysis, the terms Co-Solvent and Bi-Solvent are interchangeable. In some cases, the cleaning agent (sometimes referred to as the solvating agent) is in one chamber and the rinsing agent (sometimes referred to as the displacement agent) is in a second tank and is used sequentially. In other designs, the washing step is a mixture of cleaning agent and displacement agent.  **Rinsing/displacement with Flashpoint-inerted trans DCE**  Typically, a plant-based ester (such as a soy methyl ester is used as the cleaning or solvating agent. Nearly all current co-solvent or bi-solvent systems use flashpoint-inerted trans DCE as the displacement agent. The fluorinated inerting agents are also under scrutiny because of concerns about PFAS.  **Rinsing/displacement with alcohol (cost estimates do not reflect this possibility)**  If ingredients of flashpoint-inerted trans DCE were to become unavailable through regulatory actions or business decisions, co-solvent and bi-solvent systems are options. Barbara Kanegsberg conducted cleaning studies at Litton Guidance and Control Systems in the late 1980s- early 1990s for what we now term safety/critical military applications. Cleaning was demonstrated using cleaning agents such as d-limonene or high-boiling hydrocarbon blends followed by repeated rinsing with isopropyl alcohol. The processes were more readily and consistently accomplished using perfluorocarbons which could not be used today. These processes involved manual cleaning by highly-specialized technicians along with 100% inspection. Because current bi-solvent and co-solvent processes involve flashpoint-inerted trans-DCE as the rinsing/displacement agent, additional process development, including testing, would be needed. Low flashpoint cleaning systems would be needed – this would add to equipment costs. |
| High boiling, non-vacuum, non-rinse | This method is limited to a few general cleaning applications where cleaning agent residue could be tolerated. Examples of solvents used in such systems include d-limonene and soy methyl esters. The FP is above 37.8 deg C (100 deg F), so they would be considered not flammable by NFPA. Equipment would consist of a dip tank, most often but not necessarily heated. There could be ultrasonics or agitation. Depending on local regulations (notably those restricting VOC), there may or may not be a cover. Examples:  D-limonene (aliphatic hydrocarbon classified as a cyclic monoterpene, the major component in oils from citrus rinds)  flashpoint 48 deg C  boiling point 176 Deg C  Methyl Soyate (a mixture of long-chain, typically 16-18 carbons, fatty acid methyl esters)  flashpoint 130C  boiling point 200C |
| Semi-Aqueous | A semi-aqueous cleaning process consists of a water-miscible blend, with high solvent concentration (including emulsions), used as an immersion or spray followed by an aqueous rinse (see the description of aqueous process). Some semi-aqueous processes are referred to as aqueous (by the supplier of cleaning agent, or cleaning equipment, or by the end-user, in part because there is not a clear demarcation of the line between an aqueous additive package and a water-rinseable solvent. Equipment costs are high. Carryover of solvent into the rinse tank can be a problem. |
| Aqueous Cleaning | Aqueous cleaning involves washing with a cleaning agent that could be water alone but that typically contains organic and inorganic chemistry. The quality of the water and the amount of water used is highly variable. Depending on the application, the water quality can range from tap water to purified water, for example, de-ionized or reverse osmosis.  Aqueous formulations vary in their composition (organic and inorganic additives), the pH, and the concentration at which they are used. What is described as an aqueous process may actually be a semi-aqueous process, in large part because it has become more acceptable to avoid the concept of using any organic solvent for cleaning.  Heat and various types of cleaning action like ultrasonics, underwater agitation (like a jacuzzi or tubulation) may be used to enhance cleaning. In most instances there is significant amount of rinsing with water to displace the cleaning agent. In some instances, the rinse water may include chemicals (rust preventative (RP)) to forestall corrosion. Depending on the substrate to be cleaned and the end-use of the product, there is most often a drying step. In our model for cost comparison, we have used a wash tank followed by rinse tanks followed by a drying chamber. While we have used immersion tanks as a model to describe the aqueous process to allow comparison among the cleaning processes, in fact there is an enormous variability in aqueous cleaning processes and aqueous cleaning equipment.  The cost analyses generally consider aqueous systems to consist of one or two wash tanks followed by HOW MANY rinse tanks and a dryer. Here are a few non-encompassing examples of aqueous cleaning equipment that are not a sequence of cleaning tanks. For general cleaning applications, cleaning agent may be applied to the part either by spray or immersion. Rinsing, if it occurs may be as simple as holding the part under a tap and rinsing all residue down the drain. In some metal cleaning, the part may be washed in a spray chamber, with or without rinsing. Where rinsing occurs, it may be accomplished by placing the part over a grate and spraying water on it. Drying may not be necessary. In-line aqueous cleaning equipment is widely used to remove “no-clean” (low residue) flux from electronics assemblies, post-soldering. The cleaning action (washing and rinsing) typically involves spray-in-air. There are wash, rinse, and drying chambers. In some applications such as in some hybrid cleaning water (and/or an aqueous cleaner) is introduced into a chamber containing the parts to be cleaned. Ultrasonic cleaning and/or in cyclic cavitation (cyclic nucleation) may be used to enhance cleaning. |
| Hybrid system (e.g., Inventec, HEMO) | Hybrid systems use two or more cleaning methods in a single piece of cleaning equipment. Sometimes, the parts are cleaned in a single chamber and cleaning solutions are introduced. Other systems use sequential chambers. One equipment manufacturer described the use of an aqueous cleaning step but with a solvent rinse. This would be distinguished from a semi-aqueous process where the high-solvent cleaner is used for washing and water used for rinsing. As contrasted with co-solvent or bi-solvent systems, hybrid systems, in our definition, use an aqueous process as one of the methods, either sequentially or together as an emulsion. |

## Liquid and Aerosol Cleaners and Degreasers: AC Coil Cleaners

Air conditioner (AC) coil cleaners are used to maintain AC systems by cleaning away dust, dirt, debris, and buildup from coil fins. Keeping coils clean allows the AC system to transfer heat more efficiently. Cleaning solvents may be used in conjunction with other cleaning methods, such as blowing compressed air, vacuuming, or spraying a mixture of household detergent and water with a low-pressure sprayer. Air conditioner cleaners are available in several forms, including self-rinsing cleaners or foaming cleaners. These options are available for commercial or consumer use in aerosol form or in bulk form for use in low-pressure sprayers. Some cleaners require rinsing or wiping of excess solution.

### Solvent Ingredients

The review included one product containing methylene chloride, one product containing the priority chemical trichloroethylene, and five products containing non-priority chemical alternative solvents, including, diethylene glycol ethyl ether, water, 2-butoxy-ethanol, and others. Table 5‑5 shows the list of products reviewed for this analysis and their primary solvent ingredients.

| Table 5‑5: Safety data sheets and solvent ingredients with concentrations 5% or higher  for reviewed AC coil cleaners | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | SDS | SDS date | Solvent ingredients | Concentration (%) |
| Nu-Calgon | Cal-Blast | <https://www.nucalgon.com/media/4751/4132-20_sds_eng_v11.pdf> | 26 August 2019 | Methylene Chloride | 80 - 100 |
| d-Limonene | 1 - 5 |
| Nu-Calgon | Nu-Blast Aerosol | <https://www.nucalgon.com/media/4757/4290-75_sds_eng_v1.pdf> | 29 September 2016 | Trichloroethylene | 95 - 98 |
| Nu-Calgon | Evap Foam No Rinse Aerosol | <https://www.nucalgon.com/media/4754/4171_sds_eng_v2.pdf> | 26 February 2018 | Diethylene glycol ethyl ether | 1-5 |
| 2-Butoxyethanol | 1-5 |
| CRC | Foaming Coil Cleaner | <http://docs.crcindustries.com/msds/1003453E.pdf> | 07 October 2020 | Water | 60 - 70 |
| 2-butoxyethanol | 1 - 5 |
| Nu-Calgon | Evap Pow'r C (4168) | <https://www.nucalgon.com/media/5479/4168_sds_eng_v1.pdf> | 13 March 2019 | 2-butoxyethanol | 3 - 7 |
|  |  |
| Nu-Calgon | Blackhawk Foaming Coil Cleaner | <https://www.nucalgon.com/media/4748/4127-75_sds_eng_v1.pdf> | 26 February 2018 | Diethylene glycol monoethyl ether | 1 - 5 |
| 2-butoxyethanol | 1 - 5 |
| Sunshine Makers, Inc. | Simple Green® Foaming Coil Cleaner- non-aerosol | <https://cdn.simplegreen.com/downloads/SDS_EN-US_SimpleGreenFoamingCoilCleaner.pdf> | 1 March 2014 | Water | >77 |
| Triethanolamine | <10 |
| Propylene glycol Butyl ether | <5 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

Table 5‑6 shows the anticipated, approximate market share percentage of primary solvents used in this product category. This share percentage was estimated using the chemical ranking procedure. If restrictions were implemented for methylene chloride, then it is anticipated that aqueous and semi-aqueous solutions would be the most commonly used alternative in replacement products.

| Table 5‑6: Estimated percentage market share of solvent ingredients for AC coil cleaners | | |
| --- | --- | --- |
| Solvent | Current market share | Projections for replacement products |
| Methylene Chloride | 20% | 0% |
| Trichloroethylene | 20% | 0% |
| Water | 42% | 70% |
| 2-butoxyethanol | 7% | 11% |
| Diethylene glycol monoethyl ether | 7% | 11% |
| Other | 4% | 8% |
| Notes: The figures shown here are based on a proxy chemical ranking procedure, which draws upon factors including concentration in the product and availability and quality of product reviews. These figures are not a substitute for industry-specific information on current and projected market share. Orange shading indicates methylene chloride. Grey shading indicates another one of the first 10 TSCA work plan chemicals. Given the regulatory uncertainty while EPA considers risk management options for these chemicals, this analysis assumes any of the first 10 TSCA chemicals would not be adopted as alternative for methylene chloride while this regulatory uncertainty exists. | | |

### Volatile Organic Compounds (VOC) Content

VOC information was reviewed in product SDSs and summarized findings are in Table 5‑7. No regulatory VOC limits for AC coil cleaners were identified. There were no VOC content data available for the two products containing methylene chloride and trichloroethylene. Only two products had VOC content information listed on the SDS: Evap Foam No Rinse Aerosol (10.4%) and Simple Green® Foaming Coil cleaner- non-aerosol (2%). It was difficult to compare VOC content between products with methylene chloride and trichloroethylene and alternative products due to lack of VOC information in SDSs. However, the two alternative products with information had VOC content of around 10% or less, indicating a market share of low VOC products without methylene chloride.

| Table 5‑7: VOC content for AC coil cleaners based on information in SDSs or technical data sheets | | |
| --- | --- | --- |
| Supplier | Product | VOC (% weight, g/L) |
| Nu-Calgon | Cal-Blast | No information in SDS; likely low VOC content since 80 to 100% of product is methylene chloride |
| Nu-Calgon | Nu-Blast Aerosol | No information in SDS; likely high VOC content since 95 to 98% of product is trichloroethylene |
| Nu-Calgon | Evap Foam No Rinse Aerosol | 10.4%, 113.4 g/L |
| CRC | Foaming Coil Cleaner | No information in SDS |
| Nu-Calgon | Evap Pow'r C (4168) | No information in SDS |
| Nu-Calgon | Blackhawk Foaming Coil Cleaner | No information in SDS |
| Sunshine Makers, Inc. | Simple Green Foaming Coil Cleaner- non-aerosol | 2%, 20 g/L |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | |

### Fire Safety

Flash points and flammability ratings were reviewed in product SDSs and summarized findings are in Table 5‑8. Cal-Blast containing methylene chloride was the only product reviewed with a rating of extremely flammable. One alternative product, Evap Foam No Rinse Aerosol, did not have fire safety data. All other products were rated non-flammable. Based on the review, restricting methylene chloride from AC coil cleaners is unlikely to limit availability of non-flammable products on the market.

| Table 5‑8: Flash point and flammability ratings for AC coil cleaners based on information in SDSs or technical data sheets | | | |
| --- | --- | --- | --- |
| Supplier | Product | Flash Point | Flammability Rating |
| Nu-Calgon | Cal-Blast | No information in SDS | Extremely flammable |
| Nu-Calgon | Nu-Blast Aerosol | No information in SDS | Non-flammable |
| Nu-Calgon | Evap Foam No Rinse Aerosol | No information in SDS | Non-flammable |
| CRC | Foaming Coil Cleaner | None | Not available |
| Nu-Calgon | Evap Pow'r C (4168) | Not available | Non-flammable |
| Nu-Calgon | Blackhawk Foaming Coil Cleaner | No information in SDS | Non-flammable |
| Sunshine Makers, Inc. | Simple Green Foaming Coil Cleaner- non-aerosol | > 212 °F (100 °C) | Non-flammable |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | |

### Pricing and Customer Reviews

Pricing and customer review information was accessed on publicly available websites in July 2021 and summarized findings are in Table 5‑9. To assist in comparing prices across various products and product sizes, the prices were normalized to price per ounce. Pricing for products containing methylene chloride and trichloroethylene ranged from $0.99 (Cal-Blast) to $1.52 (Nu-Blast Aerosol) per ounce. Pricing for alternative products ranged from $0.26 (Evap Pow'r C (4168)) to $0.90 (Blackhawk Foaming Coil Cleaner) per ounce. Assuming equal effectiveness per ounce, the price range for alternative products was lower than price range for products containing methylene chloride.

All reviewed products had customer ratings, although two of these products, Cal-Blast and Simple Green Foaming Coil Cleaner- non-aerosol had fewer than 10 reviews. Ratings for products containing methylene chloride and trichloroethylene ranged from 4.4 (Nu-Blast Aerosol) to 5 (Cal-Blast), with an average rating of 4.7. Ratings for alternative products ranged from 3.7 to 4.6 with an average rating of 4.2. The average customer rating for alternative products was slightly lower than that of products with methylene chloride. However, the average rating of alternative products was over 4, indicating overall customer satisfaction with these products.

| Table 5‑9: Pricing and customer review information for AC coil cleaners based on manufacturer and retailer web pages | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | Retail information | Price per ounce | Number of Customer Reviews | Customer ratings (out of 5) |
| Nu-Calgon | Cal-Blast | <https://www.amazon.com/Nu-Calgon-4132-20-Cal-Blast-Condenser-Cleaner/dp/B01FBXMI1O> | $0.99 | 5 | 5 |
| Nu-Calgon | Nu-Blast Aerosol | <https://www.amazon.com/Nu-Calgon-4290-75-18-ounce-Condenser/dp/B00HWMXGZA> | $1.52 | 25 | 4.4 |
| Nu-Calgon | Evap Foam No Rinse Aerosol | <https://www.amazon.com/Nu-Calgon-4171-75-Rinse-Evaporator-Cleaner/dp/B00DM8KQ3I> | $0.61 | 6099 | 4.6 |
| CRC | Foaming Coil Cleaner | <https://www.amazon.com/CRC-Foaming-Cleaner-Aerosol-Yellow/dp/B009YO1FFM> | $0.53 | 545 | 4.4 |
| Nu-Calgon | Evap Pow'r C (4168) | <https://www.amazon.com/Nu-Calgon-4168-08-Evap-Rinse-Cleaner/dp/B000R7ZS08> | $0.26 | 351 | 4.4 |
| Nu-Calgon | Blackhawk Foaming Coil Cleaner | <https://www.amazon.com/Nu-Calgon-4127-75-Coil-Cleaner/dp/B00UNRCQQQ> | $0.90 | 24 | 4 |
| Sunshine Makers, Inc. | Simple Green Foaming Coil Cleaner- non-aerosol | <https://www.amazon.com/SIMPLE-GREEN-Condenser-Evaporator-Cleaner/dp/B01LZHDQGW> | $0.28 | 6 | 3.7 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

### Conclusion

The market review of AC coil cleaners included one product containing methylene chloride, one product containing trichloroethylene and five products containing a variety of alternative solvents. Barriers were not found for fire safety, pricing, or customer satisfaction that may be caused by restricting use of methylene chloride in this product category. VOCs were more difficult to compare, as none of the products containing methylene chloride and most of the alternative products lacked VOC information in their SDSs. However, two of the alternative products had VOC content close to or lower than 10%, showing that there are alternative low VOC options on the market. Most of the alternative products reviewed were rated non-flammable. The price range for alternative products was lower than price range for products containing methylene chloride. Average customer ratings of alternative products were slightly lower than that of products containing methylene chloride. Customer satisfaction was still high for alternative product ratings, as average ratings were over 4 out of 5 stars. In summary, based on the factors considered in this review, alternatives that appear to be technologically and economically feasible for users are available for methylene chloride for this product category.

## Liquid and Aerosol Cleaners and Degreasers: Brake Cleaning Products

Brake cleaning products are used to clean contaminants such as brake fluid, brake dust, dirt, grease, and oil from brake pads, linings, drums, calipers, clutches and cylinders. Many brake cleaning products are provided in aerosol form and are sprayed on the brake elements to be cleaned. The products can also be used for "off label" cleaning such as hard to reach engine parts. Aqueous brake cleaning systems are also available. These include ultrasonic washers as well as enzymatic (bio-based) washers. Ultrasonic washers use an aqueous cleaner with cavitation bubbles. Enzymatic washers use microbes to break down contaminants ([PPRC 2021](#_ENREF_57)).

Brake cleaning products are sold to both do-it-yourself retail consumers and commercial customers. Packaging sizes available include 14 ounces, 19 ounces, 1 gallon, 5 gallon and 55 gallons. In general, the products in package sizes such as 14 ounces and 19 ounces are in aerosol format with a propellant such as carbon dioxide, and the larger package sizes such as 1 gallon, 5 gallon and 55 gallons are in liquid form and do not contain a propellant. The larger package sizes are less expensive per application and can be used by shops that conduct a high volume of brake cleaning jobs. A barrel pump can be used to extract the brake cleaning fluid from the 55 gallon barrel and then used to fill pressurized handheld sprayers. Both aqueous and solvent based brake cleaning products are also available in large stationary and mobile units.

The Toxics Use Reduction Institute or TURI worked with a Massachusetts technical high school auto shop program to eliminate their use of an aerosol brake cleaning product containing another chlorinated solvent, perchloroethylene. They shifted to use of a bio-based system. The school switched to a "SmartWasher" system with "OzzyJuice" degreasing solution. The washing system cleans parts using a particulate trap and a degreasing solution in a parts washer. The particulate trap catches the large particles washed off the car parts. The degreasing solution contains microbes that break down oils and greases washed off the car parts. This approach (though not necessarily using the same brand of washing equipment) is a practical option for many auto shops ([TURI 2019](#_ENREF_67)). In another example, an auto shop in Oregon switched from a chlorinated solvent-based brake cleaner to an ultrasonic cleaning system using an all-purpose cleaner certified under EPA's Safer Choice program. TURI found that the change improved efficiency and yielded substantial financial savings ([PPRC 2021](#_ENREF_58)). The aqueous system significantly reduced labor time required for cleaning. Additional case study information is available from the Minnesota Technical Assistance Program ([MnTAP 2017](#_ENREF_41)).

### Solvent Ingredients

The most common solvents found as primary ingredients in brake cleaning products are perchloroethylene for chlorinated products and acetone for non-chlorinated products. One brake cleaning product containing methylene chloride was found. A variety of non-chlorinated co-solvents are also used such as: xylene, heptane, ethyl benzene, cyclohexane, methanol, toluene, and methyl acetate. Alternative solvents used in brake cleaners, such as n-Hexane, have been regrettable substitutions and the source of serious adverse health effects in workers ([UCB 2010](#_ENREF_113)). Table 5‑10 shows the list of products reviewed for this analysis and their primary solvent ingredients.

| Table 5‑10: Safety data sheets and solvent ingredients with concentrations 5% or higher for reviewed brake cleaning products | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | SDS | SDS Date | Solvent ingredients | Concentration (%) |
| Berryman | Brake Parts Cleaner 5C-4 1420 | <https://www.berrymanproducts.com/assets/5C-4-aerosol-1420-SDS.pdf> | 28 May 2015 | Methylene Chloride | 60 - 70 |
| Toluene | 15 - 25 |
| Perchloroethylene | 10 - 15 |
| CRC | Brake Parts Cleaner Brakleen 05089 | <http://docs.crcindustries.com/msds/1003707E.pdf> | 15 September 2020 | Perchloroethylene | 90 - 100 |
| 3M | High Power Brake Cleaner 08880 | <https://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn_zu8l00xm82UPY_1lv70k17zHvu9lxtD7SSSSSS--> | 24 June 2020 | Heptane | 50 - 60 |
| Xylene | 15 - 30 |
| Ethyl benzene | 1 – 11 |
| Methanol | 5 - 10 |
| Kelly-Heartt | True- guard Brake Cleaner | <https://s3.us-east-2.amazonaws.com/keller-heartt-assets/Data+Sheets/TRUEGARD/Truegard%20%20Brake%20Cleaner.pdf> | 12 November 2014 | Naphtha | 75 - 100 |
| Ethanol | 2.5 - 10 |
| 3M | High Power Brake Cleaner 08180 | <https://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn_zu8l00xm8_SmxtG4v70k17zHvu9lxtD7SSSSSS> | 23 May 2018 | Acetone | 40 - 70 |
| 3M | High Power Brake Cleaner 08179 | <https://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn_zu8l00xm8_ZMYt9Pv70k17zHvu9lxtD7SSSSSS--> | 4 March 2020 | Acetone | 60 - 100 |
| CRC | Non-Chlorinated Brake Parts Cleaner Brakleen 05054 | <https://docs.crcindustries.com/msds/1003670E.pdf> | 4 October 2017 | Acetone | 80 - 90 |
| CRC | Ozzy Juice SW-4 Heavy Duty Degreasing Solution | http://docs.crcindustries.com/msds/1004853E.pdf | 5 May 2020 | Water | 90 - 100 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

Table 5‑11 shows the anticipated, approximate market share percentage of primary solvents used in products estimated using the chemical ranking procedure. If restrictions were implemented for methylene chloride, then it is anticipated that acetone and water would be the most prevalent solvents used in replacement products. There are several solvents used in alternative products that contain Greenscreen Benchmark 1 chemicals such as toluene, xylene, and naphtha.[[8]](#footnote-10) In the past, hexane has been in used in alternative products and has been responsible for severe cases of occupational disease and disability when used in brake cleaners ([UCB 2010](#_ENREF_113)). These Benchmark 1 solvents are potential regrettable substitutions for methylene chloride. There are numerous commercially available alternative products for brake cleaning products without Benchmark 1 solvents.

| Table 5‑11: Estimated percentage share of solvent ingredients for reviewed brake cleaning products | | |
| --- | --- | --- |
| Ingredient | Brake Cleaner Products  (current) | Brake Cleaner Products  (projections for replacement products) |
| Methylene Chloride | 12% | 0% |
| Perchloroethylene | 22% | 0% |
| Acetone | 31% | 47% |
| Water | 10% | 16% |
| Naphtha | 9% | 13% |
| Heptane, branched, cyclic, and linear | 6% | 9% |
| Xylene | 3% | 4% |
| Toluene | 3% | 4% |
| All other solvents | 4% | 7% |
| Note: Orange shading indicates methylene chloride. Grey shading indicates another one of the first 10 TSCA work plan chemicals. Given the regulatory uncertainty while EPA considers risk management options for these chemicals, this analysis assumes any of the first 10 TSCA chemicals would not be adopted as alternative for methylene chloride while this regulatory uncertainty exists. | | |

### Volatile Organic Compounds (VOC) Content

VOC regulations for brake cleaning products are present at the state and regional level, but not at the federal level. The VOC regulations are not present in all states, but mostly for states covered by OTC and a few other states such as California. There are four different levels of VOC requirements for brake cleaning products ([ISSA 2019](#_ENREF_34)):

* States with no VOC requirements
* States with a VOC limit of 45% by weight such as Massachusetts, Illinois, Ohio, and New York
* States with a VOC limit of 10% by weight such as California, Connecticut, and Delaware
* South Coast region of California with a VOC limit of 25 g/L per Rule 1171

Table 5‑12 lists the VOC content for several brake cleaning products, based on information provided in the SDS.

| Table 5‑12: VOC Content for Brake Cleaning Products | | |
| --- | --- | --- |
| Supplier | Product | VOC  (% weight) |
| Berryman | Brake Parts Cleaner 5C-4 1420 | 21% |
| CRC | Brake Parts Cleaner Brakleen 05089 | 0% |
| 3M | High Power Brake Cleaner 08179 | 9% |
| CRC | Non-Chlorinated Brake Parts Cleaner Brakleen 05054 | 9.2% |
| 3M | High Power Brake Cleaner 08180 | 43.2% |
| 3M | High Power Brake Cleaner 08880 | 96% |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | |

Non-chlorinated brake cleaning products are commercially available to satisfy the various VOC regional and state regulations**.** For example, the 3M High Power Brake Cleaner 08180 product has VOC content of 43.2% by weight and would satisfy the states requiring a VOC limit of 45% by weight. Also, the 3M High Power Brake Cleaner 08179 product has VOC content of 9% and would satisfy the states requiring a VOC limit of 10% by weight**.** This reduced VOC content is a result of the product being composed of a significant percentage of a VOC exempt solvent – in this case acetone.

If methylene chloride were restricted from brake cleaning products, there should not be any barriers to attaining VOC compliant products since several methylene chloride and perchloroethylene free commercially available products already are using VOC exempt solvents. Acetone seems to be the VOC exempt solvent of choice for brake cleaning products. Therefore, if VOC exemption limits are further tightened in the future for brake cleaning products, then the concentration of acetone in products will likely increase.

### Fire Safety

The flash point and flammability ratings are provided in Table 5‑13 for non-aqueous brake cleaning products.

| Table 5‑13: Flash Point and Flammability Ratings for non-aqueous products | | | |
| --- | --- | --- | --- |
| Supplier | Product | Flash point | Flammability rating |
| Berryman | Brake Parts Cleaner 5C-4 1420 | None | Non-flammable |
| CRC | Brake Parts Cleaner Brakleen 05089 | None | Non-flammable |
| 3M | High Power Brake Cleaner 08180 | ≥ -156 °F | Extremely Flammable |
| CRC | Non-Chlorinated Brake Parts Cleaner Brakleen 05054 | < 0 °F | Extremely Flammable |
| 3M | High Power Brake Cleaner 08179 | > 0 °F | Extremely Flammable |
| 3M | High Power Brake Cleaner 08880 | ≥ 15 °F | Extremely Flammable |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | |

Methylene chloride and perchloroethylene are non-flammable solvents, and brake cleaning products using high concentrations of these solvents are typically non-flammable. Most solvents used as alternatives to methylene chloride in brake cleaning products have low flash points and their use results in products that are extremely flammable (flash point less than 20 °F). For example, the CRC Brake Parts Cleaner 05054 has a flash point of < 0 °F and has an "extremely flammable" rating. Aqueous brake cleaners, on the other hand, eliminate this flammability concern.

Since the non-chlorinated brake cleaning products commercially available are extremely flammable, there is a potential barrier to replace methylene chloride based products in aerosol brake cleaning applications based upon fire safety requirements. However, non-aerosol products do not pose the same fire safety concerns and are also effective.

### Removal Time

The brake cleaning products must either dissolve and wash away the target contaminants or sufficiently soften the target material so that it can be removed with a brush, microfiber cloth or rag. Removal time is the amount of time required for the target contaminants to either dissolve or be softened by continual spraying of the aerosol product onto the target contaminants. In general, the faster the brake cleaning product works, the faster the brake cleaning project will be finished and the less amount of cleaner fluid is required to complete the project. Two major factors that affect removal time are: 1) the efficiency of the brake cleaning solvents to dissolve the brake residue, and 2) the power of the spray emitted by the product. There is no publicly available information to evaluate spraying power for the various brake cleaning products.

3M has provided results for a comparison of removal time performance for two of its products and an unnamed competitor product ([3M 2021](#_ENREF_1)). The test was conducted for aerosol brake cleaning products used with oil as the target contaminant on a metal substrate. The removal time performance results are provided in Table 5‑14.

| Table 5‑14: Removal Time Performance | | | |
| --- | --- | --- | --- |
| Supplier | Product | VOC Content | Removal Time |
| 3M | High Power Brake Cleaner 08880 | 96% | 4 seconds |
| 3M | High Power Brake Cleaner 08179 | 10% | 20 seconds |
| Unnamed 3M competitor | Unnamed 3M competitor product | Not provided | 70 seconds |

To provide additional insight into any possible barriers related to removal time, the Hansen Solubility Parameters (HSP) theory (See Appendix B) can be used to predict which solvents will be able to quickly dissolve and/or soften the target solutes. Since brake contaminant removal time data and the power of the spray emitted from the product are typically not available for brake cleaning products, the HSP theory for quantifying solvent efficiency was used as the sole surrogate to estimate contaminant removal time.

The brake contaminants that need to be cleaned primarily consist of brake fluid, brake dust (including asbestos), dirt, grease and lubricating oil. The dirt and dust are often found within the brake fluid, grease, and lubricating oil and will rinse away when the brake fluid, grease, and lubricating oil are dissolved or softened. Therefore, this analysis focuses its attention on dissolving or softening the brake fluid, grease, and lubricating oil used on brake systems.

Triethylene glycol monobutyl ether appears to be the most common primary ingredient for DOT 3 brake fluids that are used in most modern cars and trucks since they work well with ABS brake systems. Table 5‑15 has a listing of brake fluid products and the concentration of triethylene glycol monobutyl ether. For each of the brake fluid products listed in Table 5‑15, triethylene glycol monobutyl ether was listed in the safety data sheet as the ingredient with the highest concentration, and therefore the HSP value for this chemical was used to represent the HSP value for brake cleaning fluids. The HSP value for triethylene glycol monobutyl ether was found to be 16.2, 6.1, 9.1, based upon using its Simplified Molecular Input Line Entry System (SMILES) chemical structure notation with the Hansen Solubility Parameters in Practice software.

| Table 5‑15: Brake Fluid Product Ingredients | | | |
| --- | --- | --- | --- |
| Supplier | Product | Safety Data Sheet | Concentration of Triethylene glycol monobutyl ether |
| Chevron | Brake and Clutch Fluid DOT 3, 4 | March 11, 2021  https://cglapps.chevron.com/sdspds/SDSDetailPage.aspx?docDataId=428068&docFormat=PDF | 20 – 30% |
| NAPA | Duty DOT 3 Brake Fluid | April 2, 2015  <https://ebpaving.com/wp-content/uploads/2013/09/Brake-fluid-DOT-3.pdf> | 5 – 50% |
| STP | Heavy Duty Brake Fluid DOT 3 | January 30, 2018  <https://www.stp.com/sites/default/files/STP%C2%AE-Heavy-Duty-Brake-Fluid-DOT-3-32oz-SDS.pdf> | 23 – 35% |

Table 5‑16 lists some lubricating oil products used for brake systems. The petroleum distillates used for these types of products are often a mixture of heavy, naphthenic hydrocarbons. For example, CAS number 64742-52-5 is a mixture of heavy, naphthenic hydrocarbons in the range of C20 to C50. Since CAS number 64742-52-5 is a variable mixture of hydrocarbons, it does not have a specific HSP value. Therefore, the HSP value of cyclotriacontane (C30) was used as a surrogate for lubricating oil products. The Hansen Solubility Parameters for cyclotriacontane was found to be 17.5, 0.1, 0.1, based upon using its SMILES chemical structure notation with the Hansen Solubility Parameters in Practice software.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 5‑16: Lubricating Oil Products Use for Braking Systems | | | |
| Supplier | Product | Safety Data Sheet | Petroleum-based ingredient |
| 3M | Anti Seize Brake Lube | December 20, 2017  https://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn\_zu8lZNUMYtx5x21Nv70k17zHvu9lxtD7SSSSSS-- | Heavy naphthenic 64641-96-4  (30 – 60%) |
| Dynatex | Brake & Caliper Lubricant | October 30, 2019  https://accumetricinc.com/uplimg/dynatex/MSDS/143493.pdf | Heavy naphthenic  64742-52-5  (60 – 80%) |

Table 5‑17 lists some grease products used for brake systems and their ingredients.

| Table 5‑17: Grease Products Used for Braking Systems | | | |
| --- | --- | --- | --- |
| Supplier | Product | Safety Data Sheet | Petroleum based ingredient |
| CRC | Heavy Duty Drum Brake Wheel Bearing Grease | August 13, 2015  https://img2.fastenal.com/infp360pmm/medias/docus/162/SDS8660014.pdf | Heavy naphthenic  64742-52-5 (60 – 70%)  Heavy paraffinic 64742-65-0 (20 – 30%) |
| Plews/ Edelmann | Lubrimatic Disc/Drum Brake Wheel Bearing Grease | January 18, 2010  <https://bishopsorchards.com/wp-content/uploads/2017/06/LUBRIMATIC-DISCDRUM-BRAKE-WHEEL-BEARING-www.msdsxchange.com_english_show_msds.cfm_filepath_GENERALPDF_PRESECTION1_1256448.pdf> | Heavy naphthenic  64742-52-5 (30 – 50%)  Heavy paraffinic 64741-88-4 (10 – 30%) |

The petroleum distillates used for grease products are often a mixture of heavy, naphthenic hydrocarbons and heavy paraffinic hydrocarbons. For example, CAS number 64741-88-4 is a mixture of heavy, paraffinic hydrocarbons in the range of C20 to C50. Therefore, the HSP value of triacontane (C30) was used as a surrogate for heavy paraffinic hydrocarbons. The Hansen Solubility Parameters for triacontane was found to be 16.0, 0.1, 0.1, based upon using its SMILES chemical structure notation with the Hansen Solubility Parameters in Practice software. The HSP value for cyclotriaconte was used as a surrogate for heavy naphthenic hydrocarbons.

The formulation ratio for grease products is approximately 2 parts heavy, naphthenic hydrocarbons to 1 part heavy, paraffinic hydrocarbons. The HSP value (17.0, 0.1, 0.1) used to represent grease products is calculated in Table 5‑18.

| Table 5‑18: HSP Calculation for Grease Products | | | | | |
| --- | --- | --- | --- | --- | --- |
| Chemical | CAS | Dispersion Force | Polar Force | Hydrogen Bonding Force | Concentration |
| Cyclotriacontane | 297-35-8 | 17.5 | 0.1 | 0.1 | 67% |
| Triacontane | 638-68-6 | 16 | 0.1 | 0.1 | 33% |
| Grease blend |  | 17.0 | 0.1 | 0.1 |  |

The HSP value (16.9, 2.1, 3.1) for the overall brake contaminant is calculated in Table 5‑19. It is assumed that the brake contaminant is composed of equal parts brake fluid, grease, and lubricating oil.

| Table 5‑19: Brake Contaminant HSP Value Calculation | | | | |
| --- | --- | --- | --- | --- |
| Chemical | Dispersion Force | Polar Force | Hydrogen Bonding Force | Concentration |
| Brake fluid | 16.2 | 6.1 | 9.1 | 33.3% |
| Lubricating oil | 17.5 | 0.1 | 0.1 | 33.3% |
| Grease | 17 | 0.1 | 0.1 | 33.3% |
| Blend | 16.9 | 2.1 | 3.1 | 100% |

For the purposes of this analysis, the HSP value (16.9, 2.1, 3.1) for the brake contaminants was used as the target solute HSP value for an effective brake cleaner. The HSP results for several products are provided in Table 5‑20. The HSP distance between the different brake cleaning products and the brake contaminants is also provided. The smaller the HSP distance to the brake contaminants, the better the anticipated removal time performance. HSP calculations are provided in Appendix B.

| Table 5‑20: HSP Values for Brake Cleaning Products | | | |
| --- | --- | --- | --- |
| Supplier | Product | HSP | HSP Distance to Brake Contaminants |
| 3M | High Power Brake Cleaner 08880 | 16.0, 1.5, 3.0 | 1.9 |
| Kelly-Heartt | True- guard Brake Cleaner | 15.5, 0.9, 1.9 | 3.3 |
| Berryman | Brake Parts Cleaner 5C-4 1420 | 17.4, 5.9, 5.0 | 4.4 |
| 3M | High Power Brake Cleaner 08180 | 15.4, 6.4, 4.5 | 5.4 |
| CRC | Brake Parts Cleaner Brakleen 05089 | 18.3, 5.7, 0.0 | 5.5 |
| 3M | High Power Brake Cleaner 08179 | 15.6, 8.9, 6.1 | 7.9 |
| CRC | Non-Chlorinated Brake Parts Cleaner Brakleen 05054 | 15.5, 9.4, 6.3 | 8.5 |
| CRC | Ozzy Juice SW-4 Heavy Duty Degreasing Solution | 15.5, 16, 42.3 | 41.7 |

In general, the lower the VOC content of non-chlorinated products, the greater the HSP distance from the brake contaminants. However, this depends upon the solvents used in the formulation.

The methylene chloride and perchloroethylene based products have a range of HSP distances between 4.4 to 5.5. There are non-chlorinated brake cleaning products (3M 08880 and 3M 08180) commercially available with HSP values that predict similar or better removal time as compared to PCE and methylene-chloride-based products. If methylene chloride was restricted from brake cleaning products, there should not be barriers due to removal time.

### Drying Time

After the brake parts have been cleaned, they can either be air dried, wiped dry with a clean rag, or used to complete the brake job with the surface still wet. Fast drying can be an advantage for shops that prefer a dry surface before completing the brake job. Fast drying time also implies rapid evaporation of the solvents into the work space, with potential consequences for occupational exposures. Many brake cleaning products tout the ability to have a fast drying time. For example, the Cyclo C111 non-chlorinated brake cleaning product has a reported dry time of 6 seconds. (Cyclo, 2021) The Cyclo C111 product is composed of 30 – 40% toluene, 30 – 40% heptane, and 20 – 30% acetone. (Cyclo, 2007).

Relative evaporation rate is the rate at which a material will evaporate compared to the rate of vaporization of a specific known material. This quantity is a ratio, and it is unitless. The relative evaporation rate of solvents is often compared to the evaporation rate of butyl acetate, which has a value of 100. As points of reference, xylene has a relative evaporation rate of 70 and is slower to evaporate than butyl acetate, and acetone has a relative evaporation rate of 630 and evaporates approximately 6 times as fast as butyl acetate.

To better understand the potential drying time for the various brake cleaning products, the relative evaporation rates for individual solvents are presented in Table 5‑21. If a solvent blend is used for the formulation of a product, then each solvent will evaporate at its own relative evaporation rate. Therefore, the solvent (including water) with the lowest relative evaporation rate within a formulation will determine the drying time for a solvent blend formulated product.

| Table 5‑21: Relative Evaporation Rate | |
| --- | --- |
| Solvent | Relative Evaporation Rate |
| D-limonene | 12 |
| Water | 30 |
| Xylene | 70 |
| Perchloroethylene | 87 |
| Ethyl benzene | 89 |
| Toluene | 190 |
| Methanol | 300 |
| Methyl cyclohexane | 300 |
| Trichloroethylene | 308 |
| Heptane | 390 |
| Cyclohexane | 560 |
| Acetone | 630 |
| Hexane | 830 |
| Methyl acetate | 1,180 |
| Methylene Chloride | 1,450 |
| Note: Orange shading indicates methylene chloride. Grey shading indicates another one of the first 10 TSCA work plan chemicals. | |

Methylene chloride has a relative evaporation rate of 1,450, and all commonly used solvents in brake cleaning products have a lower relative evaporation rate than methylene chloride. The Cyclo C111 non-chlorinated product dries in 6 seconds, so the additional drying time as compared to methylene chloride would only be a few seconds. If methylene chloride was restricted from brake cleaning products, it is not anticipated that there would be a barrier due to drying times since perchloroethylene and acetone are currently the predominant solvents used in brake cleaning products and products with both types of solvents receive high customer satisfaction ratings.

### Performance Factor: No Damage to Substrate Material

The product should not stain, discolor, or alter the substrate, or corrode a metal substrate. In general, the chlorinated and non-chlorinated brake cleaning products are marketed as being compatible with braking systems substrate materials. If methylene chloride was restricted from brake cleaning products, there should not be any barriers to replace these products with non-chlorinated alternatives, including water-based products, because of concerns for damaging substrate material.

### Irritating Odor

Brake cleaning products that emit strong and/or irritating odors may be unpleasant to the user. It should be noted that products containing hazardous solvents should be used with proper ventilation and personal protective equipment. Further, the unpleasant odor of hazardous solvents can serve as a warning of inhalation exposure to the hazardous solvent. Each solvent has an odor detection threshold and a concentration level that becomes irritating to humans. Table 5‑22 provides a listing of odor detection thresholds and irritating concentration levels for common solvents and solvents used in brake cleaning products ([Ruth 1986](#_ENREF_60)).

Solvents with low irritating concentration levels (such as below 100 mg/m3) are often considered strong and offensive, such as hydrogen sulfide, acetic acid, and formic acid.

| Table 5‑22: Low Odor Detection Threshold and Irritating Concentrations of Solvents | | |
| --- | --- | --- |
| Solvent | Lowest Odor Detection Threshold Concentration (mg/m3) | Irritating Concentration (mg/m3) |
| Hydrogen sulfide | 0.0007 | 14 |
| Acetic acid | 2.5 | 25 |
| Formic acid | 0.045 | 27 |
| Naphthalene | 1.5 | 75 |
| Xylene | 0.35 | 435 |
| Acetone | 47.5 | 475 |
| Toluene | 8.0 | 750 |
| Trichloroethylene | 1.1 | 864 |
| Ethyl benzene | 8.7 | 870 |
| Cyclohexane | 1.4 | 1,050 |
| Perchloroethylene | 31.4 | 1,340 |
| Methylene chloride | 540 | 8,280 |
| Methanol | 13.1 | 22,875 |
| Methyl acetate | 610 | 30,497 |
| Note: Orange shading indicates methylene chloride. Grey shading indicates another one of the first 10 TSCA work plan chemicals. | | |

The low odor detection levels and irritating concentration levels were not found in the literature for many solvents used in brake cleaning products such as d-limonene and naphtha. However, these odor levels were found for many other solvents used in brake cleaning products such as xylene, acetone, ethyl benzene, cyclohexane, methanol, toluene, and methyl acetate. The range of odor detection levels for these solvents was xylene (0.35 mg/m3) to methyl acetate (610 mg/m3). The range of irritating concentration levels for these solvents was xylene (435 mg/m3) to methyl acetate (30,497 mg/m3).

Some brake cleaner solvents such as xylene have lower odor detection and irritating concentration levels than perchloroethylene. Some solvents such as methyl acetate have higher odor detection and irritating concentration levels than perchloroethylene. Acetone provides a comparable odor detection threshold and irritating concentration to perchloroethylene. It should be noted that products containing hazardous solvents should be used with proper personal protective equipment.

### Pricing and Customer Reviews

Retail price can be a factor for market acceptance of brake cleaning products. These products are available in a variety of sizes and price levels. The prices for these products are listed in Table 5‑23. This pricing information was accessed on publicly available websites during February 2021. To assist in comparing the prices across various products and product sizes, the prices were normalized to price per ounce.

Table 5‑23 provides a representative, but not exhaustive, listing of commercially available brake cleaning products, including the supplier name, product name, URL for product information, customer reviews, and pricing information. A high level of customer satisfaction was achieved for both chlorinated and non-chlorinated brake cleaning products based on customer ratings of 4.6 or higher using a 5-star rating system.

| Table 5‑23: Commercially Available Brake Cleaning Products | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | Product Information | Price per ounce | Customer rating | Customer reviews |
| Berryman | Brake Parts Cleaner 5C-4 1420 | https://www.amazon.com/Berryman-1420-Brake-Cleaner-Compliant/dp/B0002JM886 | $0.55 | 5 | 4 |
| CRC | Brake Parts Cleaner Brakleen 05089 | <https://www.homedepot.com/p/CRC-19-oz-Brake-Parts-Cleaner-Brakleen-05089/205021970> | $0.26 | 4.8 | 15 |
| <https://www.amazon.com/CRC-05089-BRAKLEEN-Brake-Cleaner/dp/B000LDR9HI> | $0.21 | 4.8 | 9,081 |
| <https://www.grainger.com/product/5YK77> | $0.41 | None | None |
| CRC | Non-Chlorinated Brake Parts Cleaner Brakleen 05054 | <https://www.homedepot.com/p/CRC-14-fl-oz-Non-Chlorinated-Brake-Parts-Cleaner-Brakleen-05054/205021971> | $0.30 | 5 | 4 |
| <https://www.amazon.com/CRC-05084-BRAKLEEN-Brake-Cleaner-Non-Chlorinated-14/dp/B000BXKZUQ> | $0.70 | 4.7 | 666 |
| 3M | High Power Brake Cleaner 08880 | <https://www.amazon.com/3M-08880-Power-Brake-Cleaner/dp/B0002FU44K/ref=sr_1_3?dchild=1&keywords=3m+brake+cleaner+08880&qid=1612798683&sr=8-3> | $0.62 | 4.6 | 480 |
| <https://shop.advanceautoparts.com/p/3m-high-power-brake-cleaner-14-oz-08880/7670001-P> | $0.39 Regular,  $0.25  Sale | 4.9 | 63 |
| 3M | High Power Brake Cleaner 08180 | <https://www.amazon.com/3M-08180-Power-Brake-Cleaner/dp/B002WQHY9K> | $0.62 | 4.6 | 480 |
| 3M | High Power Brake Cleaner 08179 | <https://www.amazon.com/3M-08179-Power-Brake-Cleaner/dp/B005RNCZ4E> | $0.71 | 4.6 | 480 |
| Kelly-Heartt | True- guard Brake Cleaner | <https://www.amazon.com/TRUEGARD-Brake-Cleaner-55-Gallon-Drum/dp/B01LW6L1CS> | $0.08 | 4.5 | 8 |
| CRC | 14740 SW-23 Smart Washer Mobile SW-4 Ozzyjuice | <https://www.amazon.com/CRC-14740-Gallon-Smart-Washer/dp/B01AP9UXEI> | $1,673  Reusable system | 4.3 | 5 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

The Berryman brake cleaning product containing methylene chloride has a price of $0.55 per ounce. The CRC brake cleaning product containing perchloroethylene has a price range of $0.21 per ounce (Amazon) to $0.41 per ounce (Grainger). The non-chlorinated, solvent-based brake cleaning products have a price range of $0.25 per ounce to $0.71 per ounce. The reusable aqueous brake cleaning product CRC 14740 in non-aerosol and requires a heating element since the Ozzy juice temperature must be maintained at 105 – 115 degrees F. An OzzyMat is used as a filter and needs to be changed every 30 days.

Since at least one high performing (removal time) non-chlorinated brake cleaning product (3M 08880) has a price level in the range of products containing methylene chloride or perchloroethylene, there does not appear to be a price barrier for restricting the use of methylene chloride in brake cleaning products.

### Conclusion

There are chemical alternative brake cleaners available in both aerosol and non-aerosol forms that perform the tasks needed for brake cleaning that are technologically and economically feasible. Based upon this limited evaluation of the current market for brake cleaning products, it appears that there is a potential fire safety barrier to moving from methylene chloride-based brake cleaning products to alternative solvent-based aerosol products, although non-aerosol and aqueous products provide alternatives with greater fire safety and preventing worker inhalation of asbestos, still present in some brakes and clutches, or other dusts that become airborne during the brake cleaning process. There is no evidence that suggests restrictions on the use of methylene chloride would result in the use of trichloroethylene, n-Methylpyrrolidone (NMP), or 1-bromopropane for these types of products, particularly given the increasing regulatory scrutiny for these solvents.

## Liquid and Aerosol Cleaners and Degreasers: Carburetor Cleaner

Carburetor cleaners work to clean deposits and build up off carburetor injectors. Build up can clog injectors and inhibit flow of fuel into an engine. There are cleaners on the market for most small and large engines. Carburetor cleaners are sold in aerosol cans (typically 12 ounces) to be sprayed on, in, or around a carburetor, or in a concentrated liquid (around 6 or more depending on the engine type ounces) intended to be poured into the fuel tank and allowed to flow through the carburetor.

### Solvent Ingredients

The review included two products containing methylene chloride, and six products containing alternative solvents including acetone, methanol, petroleum distillates, and others. Table 5‑24 shows the list of products reviewed for this analysis and their primary solvent ingredients.

| Table 5‑24: Safety data sheets and solvent ingredients with concentrations 5% or higher for reviewed carburetor cleaners | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | SDS | SDS date | Solvent ingredients | Concentration (%) |
| Blumenthal Brands Integrated LLC | Gunk Carburetor Parts Cleaner - Chlorinated | <https://www.solvewithb.com/products/msds/M4814.pdf> | 20 November 2015 | Methylene Chloride | 60 - <70 |
| Xylene | 10 - <20 |
| Toluene | 10 - <20 |
| Amrep Automotive Products Group | AutoZone Carburetor Cleaner | <https://contentinfo.autozone.com/znetcs/msds/en/US/593715> | 14 June 2004 | Methylene Chloride | 40 - 60 |
| Methanol | 20 - 30 |
| Toluene | 15 - 25 |
| CRC | Clean R Carb Carburetor Cleaner (50 State Formula) | <http://docs.crcindustries.com/msds/1003802E.pdf> | 04 October 2017 | Acetone | 80 - 90 |
| CRC | Clean R Carb Carburetor Cleaner | <http://docs.crcindustries.com/msds/1003690E.pdf> | 20 April 2020 | Methanol | 30 - 40 |
| Toluene | 30 - 40 |
| Acetone | 20 - 30 |
| CRC | Carboretor and Choke Cleaner | <http://docs.crcindustries.com/msds/1003337E.pdf> | 04 October 2017 | Acetone | 80 - 90 |
| n-heptane | 3 - 5 |
| ITW Brands | Gumout Fuel Injector Carburetor Cleaner | <https://3enoro1q5ve12ubndv13jkpk-wpengine.netdna-ssl.com/wp-content/uploads/2017/05/510021-800001373-Gumout-Fuel-Injector-Carburetor-Cleaner.pdf> | 14 April 2015 | Distillates (petroleum), hydrotreated light | 60 - 100 |
| WD-40 Company | WD 40 Specialist Carb Throttle Body Parts Cleaner | <https://files.wd40.com/pdf/sds/specialist/wd-40-specialist-carb-throttle-body-parts-cleaner-us-ghs-sds.pdf> | 27 August 2018 | Acetone | 80 - 90 |
| Heptane | <10 |
| Blumenthal Brands Integrated LLC | Gunk Carburetor Parts Cleaner - Non Chlorinated | <https://www.solvewithb.com/products/msds/M4815NC.pdf> | 16 October 2018 | Acetone | 70 - <80 |
| Distillates (petroleum), Hydrotreated Light | 10 - <20 |
| Xylene | 5 - <10 |
| Ethylbenzene | 3 - <5 |
| Note: Orange shaded rows indicate products that contain methylene chloride. | | | | | |

Table 5‑25 shows the anticipated, approximate market share percentage of primary solvents used in products estimated using the chemical ranking procedure. If restrictions are placed on methylene chloride, then acetone and petroleum distillates would have the highest anticipated use. There are several solvents used in alternative products that contain Greenscreen Benchmark 1 chemicals such as toluene, xylene, ethyl benzene, and methanol.[[9]](#footnote-11) These Benchmark 1 solvents are potential regrettable substitutions for methylene chloride. There are numerous commercially available alternative products for carburetor cleaner products without Benchmark 1 solvents.

| Table 5‑25: Estimated percentage share of solvent ingredients for reviewed carburetor cleaners | | |
| --- | --- | --- |
| Solvent | Current market share | Projections for replacement products |
| Methylene Chloride | 23% | 0% |
| Acetone | 45% | 58% |
| Petroleum distillates | 15% | 20% |
| Toluene | 8% | 10% |
| Methanol | 4% | 6% |
| Other solvents | 5% | 6% |
| Notes: The figures shown here are based on a proxy chemical ranking procedure, which draws upon factors including concentration in the product and availability and quality of product reviews. Orange shading indicates methylene chloride. Given the regulatory uncertainty while EPA considers risk management options for these chemicals, this analysis assumes any of the first 10 TSCA chemicals would not be adopted as alternative for methylene chloride while this regulatory uncertainty exists. | | |

### Volatile Organic Compounds (VOC) Content

VOC information was reviewed in product SDSs and summarized findings are in Table 5‑26. EPA limits VOCs in carburetor cleaners to 75%. However, many states regulate VOCs in this product category to either 10% (*e.g.*, California) or 45%. The two products containing methylene chloride contained 44% (Gunk Carburetor Parts Cleaner – Chlorinated) and 79% (AutoZone Carburetor Cleaner) VOCs. Both of these options would have limitations on sales in the US. Five of the six alternative products reviewed contained £10% VOCs, which is within the regulatory limits of the U.S. EPA and all US states. One alternative product, Clean R Carb Carburetor Cleaner, contained 70% VOCs, which would be limited in a number of US states. There would likely be no barrier in low VOC product availability with stronger restrictions on methylene chloride, as EPA found several options in the product review that have low VOCs to meet all state and federal VOC requirements.

| Table 5‑26: VOC content for carburetor cleaners based on information in SDSs or technical data sheets | | |
| --- | --- | --- |
| Supplier | Product | VOC  (% weight, g/L) |
| Blumenthal Brands Integrated LLC | Gunk Carburetor Parts Cleaner - Chlorinated | 44% |
| Amrep Automotive Products Group | AutoZone Carburetor Cleaner | 78.75% |
| CRC | Clean R Carb Carburetor Cleaner (50 State Formula) | 9%, 70.2 g/L |
| CRC | Clean R Carb Carburetor Cleaner | 70%, 575.4 g/L |
| CRC | Carboretor and Choke Cleaner | 9%, 70.2 g/L |
| ITW Brands | Gumout Fuel Injector Carburetor Cleaner | <1% |
| WD-40 Company | WD 40 Specialist Carb Throttle Body Parts Cleaner | 10% |
| Blumenthal Brands Integrated LLC | Gunk Carburetor Parts Cleaner - Non Chlorinated | < 10% |
| Note: Orange shading indicates methylene chloride. | | |

### Fire Safety

Flash points and flammability ratings were reviewed in product SDSs and summarized findings are in Table 5‑27. One of the products containing methylene chloride (Gunk Carburetor Parts Cleaner – Chlorinated) was rated non-flammable, and the other product (Autozone) was rated as extremely flammable. Even though the Autozone product contains methylene chloride which is non-flammable, the overall product formulation is extremely flammable due to the high content of methanol and toluene in the formulation. Five of the alternative products reviewed were rated extremely flammable, and one was rated non-flammable (Gumout Fuel Injector Carburetor Cleaner). The availability of non-flammable products on the market may not be affected with the removal of methylene chloride, as there is a mix of flammable and non-flammable products currently available on the market containing methylene chloride and alternative solvents.

| Table 5‑27: Flash point and flammability ratings for carburetor cleaner products based on information in SDSs or technical data sheets | | | |
| --- | --- | --- | --- |
| Supplier | Product | Flash Point | Flammability Rating |
| Blumenthal Brands Integrated LLC | Gunk Carburetor Parts Cleaner - Chlorinated | None | Non-flammable |
| Amrep Automotive Products Group | AutoZone Carburetor Cleaner | 0.4 °F (-17.6) | Extremely flammable |
| CRC | Clean R Carb Carburetor Cleaner (50 State Formula) | < 0 °F (< -17.8 °C) | Extremely flammable |
| CRC | Clean R Carb Carburetor Cleaner | 0 °F (-17.8 °C) | Extremely flammable |
| CRC | Carboretor and Choke Cleaner | < 0 °F (< -17.8 °C) | Extremely flammable |
| ITW Brands | Gumout Fuel Injector Carburetor Cleaner | 183 °F (83.9 °C) | Non-flammable per CPSC standards  (Listed as Combustible in SDS) |
| WD-40 Company | WD 40 Specialist Carb Throttle Body Parts Cleaner | -4°F (-20 °C) | Extremely flammable |
| Blumenthal Brands Integrated LLC | Gunk Carburetor Parts Cleaner - Non Chlorinated | -20.0 °F (-28.9 °C) | Extremely flammable |
| Note: Orange shaded rows indicate products that contain methylene chloride. | | | |

### Pricing and Customer Reviews

Pricing and customer review information was accessed on publicly available websites in July 2021 and summarized the findings are in Table 5‑28. To assist in comparing prices across various products and product sizes, the prices were normalized to price per ounce. Pricing for products containing methylene chloride ranged from $0.21 to $0.24 per ounce. Alternative product prices ranged from $0.24 to $0.76. The pricing range for products containing alternative solvents had an overlap at $0.24 with pricing for methylene chloride products.

The two products containing methylene chloride had customer ratings ranging from 4.7 (Gunk Carburetor Parts Cleaner - Chlorinated) to 4.8 (AutoZone Carburetor Cleaner) with an average of around 4.8. The alternative products had ratings ranging from 4.5 (Clean R Carb Carburetor Cleaner) to 4.9 (Gunk Carburetor Parts Cleaner - Non Chlorinated) with an average rating of 4.7. The average rating of products containing an alternative solvent is about the same as that of the product containing methylene chloride. The high average rating of alternative products also indicating that customers were satisfied with their experiences using alternative products. Based on the customer rating information reviewed, restricting methylene chloride in this product category is unlikely to limit effective options on the market that work well for consumers.

| Table 5‑28: Pricing and customer review information for carburetor cleaner products based on manufacturer and retailer web pages | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | Retail information | Price per ounce | Customer ratings (out of 5) | Number of customer reviews |
| Blumenthal Brands Integrated LLC | Gunk Carburetor Parts Cleaner - Chlorinated | <https://shop.advanceautoparts.com/p/gunk-carburetor-parts-cleaner-chlorinated-m4814/7040288-p> | $0.24 | 4.7 | 32 |
| Amrep Automotive Products Group | AutoZone Carburetor Cleaner | <https://www.autozone.com/fuel-and-engine-cleaners-additives/carburetor-and-throttle-body-cleaner/autozone-carburetor-cleaner-12oz/593715_0_0> | $0.21 | 4.8 | 148 |
| CRC | Clean R Carb Carburetor Cleaner (50 State Formula) | <https://www.amazon.com/CRC-05379-Clean-R-Carb-Carburetor-Cleaner/dp/B007UTM8ZE> | $0.76 | 4.6 | 13 |
| CRC | Clean R Carb Carburetor Cleaner | <https://www.amazon.com/CRC-05081-Clean-R-Carb-Carburetor-Cleaner/dp/B000CITXGM> | $0.74 | 4.5 | 17 |
| CRC | Carboretor and Choke Cleaner | <https://www.amazon.com/CRC-Choke-Cleaner-Aerosol-Clear/dp/B00869JG02> | $0.50 | 4.6 | 277 |
| ITW Brands | Gumout Fuel Injector Carburetor Cleaner | <https://www.amazon.com/dp/B00434L0NU> | $0.32 | 4.7 | 118 |
| WD-40 Company | WD 40 Specialist Carb Throttle Body Parts Cleaner | <https://www.amazon.com/WD-40-Specialist/dp/B07WPFF5T1> | $0.47 | 4.7 | 1480 |
| Blumenthal Brands Integrated LLC | Gunk Carburetor Parts Cleaner - Non Chlorinated | <https://shop.advanceautoparts.com/p/gunk-carburetor-parts-cleaner-non-chlorinated-m4815nc/10442688-P> | $0.24 | 4.9 | 32 |
| Note: Orange shaded rows indicate products that contain methylene chloride. | | | | | |

### Conclusion

The market review of carburetor cleaners included two products containing methylene chloride, and six products containing a variety of alternative solvents. Barriers were not found around VOCs or customer satisfaction that may be caused by restricting the use of methylene chloride in this product category. Overall, technologically and economically feasible alternatives are available in the marketplace. Five of the alternative products had VOC £10%, which is within the regulatory VOC limits of all US states. One of the two methylene chloride containing products was rated as highly flammable. One of the alternative products was rated non-flammable, indicating some market share of alternative non-flammable products. The pricing range for products containing alternative solvents had an overlap at $0.24 with pricing for methylene chloride products, where one alternative product had the same price per ounce as a product containing methylene chloride. The average customer rating of alternative products was about the same as products containing methylene chloride with reviews. Customer satisfaction was high for alternative product ratings, as average ratings were around 4.7 out of 5 stars.

## Paint and Coating Removers

Paint and coating removal products are used for the removal of a wide range of coatings including paints (oil, latex), varnishes, lacquers, shellacs, epoxies, adhesives, asphalt/tar, and polyurethanes. These products are also used on multiple substrate materials: wood, metal, ceramic tile, and masonry.

Paint and coating removal products are sold to both do-it-yourself retail consumers and commercial customers in packaging sizes ranging from 16 ounces to 55-gallon drums.

### Solvent Ingredients

This review included two products containing methylene chloride and one containing NMP. Twelve other products were assessed and contained alternative solvents including acetone, dimethyl carbonate, methyl acetate, dimethyl sulfoxide, benzyl alcohol, ethyl benzene, xylene, and others. Table 5‑29 shows the list of products reviewed for this analysis and their primary solvent ingredients.

| Table 5‑29: Safety data sheets and solvent ingredients with concentrations 5% or higher for  reviewed paint and coating removal products | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | SDS | SDS date | Solvent ingredients | Concentration (%) |
| Columbia Coatings | Rapid Strip Liquid | <https://www.columbiacoatings.com/shared/images/SDS/Rapid-Strip-Liquid-SDS.pdf> | 17 January 2020 | Methylene Chloride | 75 - 95 |
| Methanol | 5 - 15 |
| Benco | B17 | <https://www.columbiacoatings.com/shared/images/MSDS/Chemicals/B17-Industrial-Paint-Remover-MSDS.pdf> | No date | Methylene Chloride | 50 – 60 |
| phenol | 12 - 20 |
| formic acid | 12 - 20 |
| Sunnyside | Aqua Strip | <https://www.sunnysidecorp.com/pdfs/MSDS_650G1Z.pdf> | 09 June 2009 | NMP | 15 - 30 |
| Dimethylglyoxime | 20 - 35 |
| Dimethylacetamide | 5 - 15 |
| Dimethyl sulfate | 5 - 15 |
| Other | 20 - 40 |
| EZ Strip | Max Strip Paint and Varnish Stripper | <https://maxstrip.com/wp-content/uploads/Max-Strip_Paint-and-Varnish-Stripper_SDS.pdf> | 1 March 2019 | Triethyl phosphate | 3 - 7 |
| W.M. Barr | Jasco Premium Paint & Epoxy Remover | <https://images.thdstatic.com/catalog/pdfImages/67/6723bc15-ee5e-468f-ac84-4e9d23d94cac.pdf> | 02 March 2021 | Dimethyl carbonate | 30 – 60 |
| Dimethyl Sulfoxide | 10 – 30 |
| xylene | 10 – 30 |
| ethyl benzene | 1 - 5 |
| W.M. Barr | Citristrip | <https://images.thdstatic.com/catalog/pdfImages/5b/5be0bda6-5eec-4548-b3b8-a5e0c7795a56.pdf> | 06 January 2021 | Benzyl alcohol | 30 - 60 |
| Diethylene glycol monobutyl ether | 5 - 10 |
| W.M. Barr | Green Paint & Varnish Stripper | <https://assets.unilogcorp.com/187/ITEM/DOC/Klean_Strip_102439529_SDS.pdf> | 28 July 2015 | Benzyl alcohol | 20 - 40 |
| alcohol ethoxylates | <5% |
| W.M. Barr | Klean Strip Premium | <https://images.thdstatic.com/catalog/pdfImages/37/37b90dd4-c178-48b4-b10b-6ea2113c7b0e.pdf> | 21 February 2019 | Dimethyl carbonate | 30 – 60 |
| Dimethyl Sulfoxide | 10 - 30 |
| xylene | 10 – 30 |
| ethyl benzene | 1 - 5 |
| W.M. Barr | Klean Strip Premium – CA formula | <https://images.thdstatic.com/catalog/pdfImages/34/34a766aa-d397-4107-95fb-8c4478f7783d.pdf> | 17 December 2020 | Acetone | 30 – 60 |
| Dimethyl Sulfoxide | 10 - 30 |
| Xylene | 10 - 30 |
| ethyl benzene | 1 - 5 |
| W.M. Barr | Kwik Strip | <https://kleanstrip.com/kwik-strip/kwik-strip-paint-varnish-stripper/> | 17 September 2018 | Dimethyl carbonate | 30 – 60 |
| Dimethyl Sulfoxide | 10 - 30 |
| Xylene | 10 - 30 |
| ethyl benzene | 1 - 5 |
| Dumond Chemicals | Smart Strip Advanced | <https://cdn.shopify.com/s/files/1/0507/1713/0939/files/Smart_Strip_SDS.pdf?v=1615304683> | 1 December 2020 | Water | 40 – 60 |
| benzyl alcohol | 30 - 50 |
| Dumond Chemicals | Safe 'n Easy Citrus Paint & Varnish Remover Gel | <https://cdn.shopify.com/s/files/1/0507/1713/0939/files/Safe__n_Easy_Citrus_Paint___Varnish_Remover_SDS.pdf?v=1615317935> | 1 December 2020 | Benzyl alcohol | 30 - 40 |
| glycolic acid | 1 - 10 |
| Sunnyside | 2 Minute Remover | <https://www.sunnysidecorp.com/pdfs/SDS_635G1.pdf> | 06 September 2018 | Dimethyl carbonate | 10 - 25 |
| acetone | 25 - 45 |
| 1,3 dioxolane | 25 - 45 |
| hydrotreated distillates | < 10 |
| methanol | < 10 |
| Sunnyside | High Speed Ready Strip | <https://www.sunnysidecorp.com/pdfs/SDS_68532.pdf> | 15 May 2015 | Trade secret | 15 - 40 |
| Super Remover | New Generation | <https://www.superremover.com/wp-content/uploads/2019/06/SuperRemover_New-Generation_USA_SDS_EN_Nov-2018-1.pdf> | 12 October 2018 | Methyl acetate | 45 – 70 |
| 1,3 dioxolane | 5 - 40 |
| Dimethyl Sulfoxide | 5 - 40 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

Table 5‑30 shows the anticipated, approximate market share percentage of primary solvents used in products estimated using the chemical ranking procedure. If further restrictions were implemented for methylene chloride, then it is anticipated that dimethyl carbonate and benzyl alcohol would be the most prevalent solvents used in replacement products. There are several solvents used in alternative products that contain Greenscreen Benchmark 1 chemicals such as xylene, ethyl benzene, and methanol.[[10]](#footnote-12) These Benchmark 1 solvents are potential regrettable substitutions for methylene chloride. There are numerous commercially available alternative products for paint and coating removal products without Benchmark 1 solvents.

| Table 5‑30: Estimated percentage share of solvent ingredients for reviewed paint and coating removal products | | |
| --- | --- | --- |
| Solvent | Current market share | Projections for replacement products |
| Methylene Chloride | 14% | 0% |
| NMP | 2% | 0% |
| Dimethyl carbonate | 19% | 22% |
| Benzyl alcohol | 16% | 18% |
| Acetone | 9% | 10% |
| Dimethyl Sulfoxide | 8% | 9% |
| Xylene | 7% | 8% |
| Water | 7% | 8% |
| Methyl acetate | 5% | 6% |
| 1,3 dioxolane | 4% | 4% |
| Dimethyl glutarate | 3% | 3% |
| Ethyl benzene | 2% | 2% |
| Other | 4% | 10% |
| Notes: The figures shown here are based on a proxy chemical ranking procedure, which draws upon factors including concentration in the product and availability and quality of product reviews. Orange shading indicates methylene chloride. Grey shading indicates another one of the first 10 TSCA work plan chemicals. Given the regulatory uncertainty while EPA considers risk management options for these chemicals, this analysis assumes any of the first 10 TSCA chemicals would not be adopted as alternative for methylene chloride while this regulatory uncertainty exists. | | |

### Volatile Organic Compounds (VOC) Content

The EPA reviewed VOC information in product SDSs and summarized findings in Table 5‑31. The paint and coating removal products should have VOC content less than 50% by weight so that they can meet the VOC requirements for various U.S. states. To achieve this requirement, the products should contain 50% or greater of VOC-exempt solvents such as methyl acetate, dimethyl carbonate, acetone, and water. Most paint and coating removal product safety data sheets provide VOC content for the entire product, and percentage composition ranges for each of the chemicals in the product**.**

| Table 5‑31: VOC content for adhesive paint and coating removal products based on information in SDSs or technical data sheets | | |
| --- | --- | --- |
| Supplier | Product | VOC  (% weight) |
| Columbia Coatings | Rapid Strip Liquid | Not listed on SDS |
| Benco | B17 | Not listed on SDS |
| Sunnyside | Aqua Strip | Not listed on SDS |
| EZ Strip | Max Strip Paint and Varnish Stripper | Not listed on SDS |
| W.M. Barr | Jasco Premium Paint & Epoxy Remover | 48.87% |
| W.M. Barr | Citristrip | 0.51% |
| W.M. Barr | Green Paint & Varnish Stripper | Not listed on SDS |
| W.M. Barr | Klean Strip Premium | 48.87% |
| W.M. Barr | Klean Strip Premium – CA formula | 50% |
| W.M. Barr | Kwik Strip | 48.87% |
| Dumond Chemicals | Smart Strip Advanced | 0% |
| Dumond Chemicals | Safe 'n Easy Citrus Paint & Varnish Remover Gel | Not listed on SDS |
| Sunnyside | 2 Minute Remover | Not listed on SDS |
| Sunnyside | High Speed Ready Strip | Not listed on SDS |
| Super Remover | New Generation | Not listed on SDS |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | |

If methylene chloride were restricted from paint and coating removal products, there should not be any barriers to attaining VOC compliant products since several methylene chloride free commercially available products already are using VOC exempt solvents to enable the product to be VOC compliant.

### Fire Safety

EPA reviewed flash points and flammability ratings in product SDSs for the various paint and coating removal products and summarized the findings in Table 5‑32.

Evaporation barriers are chemical additives that are often included in coating removal formulations to block solvent evaporation and slow down the drying process. This enables the coating removal product to stay wet on the surface of the coatings to be stripped. Coating removal products lose their effectiveness when they dry out. The use of evaporation barriers also mitigates fire hazard by blocking the generation of solvent vapors which are needed to exceed the lower flammability limit and start a fire.

Manufacturers of paint and coating removal products can mitigate the fire hazard of their coating removal products with one of the following approaches: a) a flash point greater than 100 F, or b) an effective evaporation barrier to block solvent evaporation.

| Table 5‑32: Flash point and flammability ratings for coating and removal products based on information in SDSs or technical data sheets | | | | |
| --- | --- | --- | --- | --- |
| Supplier | Product | Fire Hazard Mitigation Strategy | Flash Point | Flammability Rating |
| Columbia Coatings | Rapid Strip Liquid | Flash point above 100 °F | None | Non-flammable |
| Benco | B17 | Flash point above 100 °F | None | Non-flammable |
| Sunnyside | Aqua Strip | Flash point above 100 °F | > 200 °F | Non-flammable |
| EZ Strip | Max Strip Paint and Varnish Stripper | Flash point above 100 °F | 9,034 °F | Non-flammable |
| W.M. Barr | Jasco Premium Paint & Epoxy Remover | Not known | 74 °F | Flammable |
| W.M. Barr | Citristrip | Flash point above 100 °F | > 200 °F | Non-flammable |
| W.M. Barr | Green Paint & Varnish Stripper | Flash point above 100 °F | No data | Non-flammable |
| W.M. Barr | Klean Strip Premium | Not known | 74 °F | Flammable |
| W.M. Barr | Klean Strip Premium – CA formula | Not known | 0 °F | Extremely flammable |
| W.M. Barr | Kwik Strip | Evaporation Barrier | 74 °F | Flammable |
| Dumond Chemicals | Smart Strip Advanced | Flash point above 100 °F | None | Non-flammable |
| Dumond Chemicals | Safe 'n Easy Citrus Paint & Varnish Remover Gel | Flash point above 100 °F | No data | Non-flammable |
| Sunnyside | 2 Minute Remover | Neither - Flash point below 20 °F without evaporation barrier | No data | Extremely flammable |
| Sunnyside | High Speed Ready Strip | Flash point above 100 °F | 201 °F | Non-flammable |
| Super Remover | New Generation | Evaporation Barrier | 23 °F | Flammable |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | |

### Coating Removal Performance

The amount of time required to remove a coating is an important performance factor for consumers using paint and coating removal products. Methylene chloride-based coating removal products are considered fast acting since they remove many types of multilayer coatings in 30 minutes or less. There are many commercially available stripping products that are slow acting and require several hours to remove most types of multilayer coatings. There is a consumer market available for both fast-acting and slow-acting coating removal products since they both ultimately remove the coatings from the substrate material. For some coating removal applications, the time to remove the paint coatings is the primary consideration, and therefore fast-acting coating removal products are preferred. For others, a quick time to remove the paint coatings is not required; it may be acceptable to leave the coating removal product on the substrate for several hours or even overnight until the stripping job is complete. In these situations, the consumer's primary needs may be odor, viscosity, cleanup method, or other factors, and slow-acting coating removal products are acceptable.

In 2020, the Toxics Use Reduction Institute published a report containing performance testing results for fast and slow acting paint strippers ([TURI 2020](#_ENREF_68)). The objective of the performance tests was to determine the required duration for coating removal products to remove 90% or more of the coating from the surface of a substrate material.

Standard wood panels were created to ascertain the stripping performance for epoxy and varnish. The standard panels were first coated with Kilz Original Interior Oil-Based primer, and then four layers of either epoxy or varnish. Mixed test panels were created to simulate a scenario where a substrate has different coating types applied over time. The mixed test panels had an oil primer layer, a latex-based paint layer, an oil-based paint layer, another latex-based paint layer, another oil-based paint layer, and two layers of polyurethane.

The fast-acting products were tested with a total dwell time of 30 minutes for epoxy standard panels, 32 minutes for standard varnish panels, and 35 minutes for mixed panels. The test was considered completed if 90% or higher percentage of the underlying substrate surface was exposed.

For slow acting products, the coating removal performance was inspected after one hour dwell time increments until 90% or higher amount of the underlying substrate surface was exposed. Table 5‑33 provides the dwell time required for removal of 90% or more of the coating. For the products not tested, the determination of whether the product is fast acting or slow acting was determined by the solvent ingredients.

The following coating products were used for the standard and mixed coupons:

* Primer: Kilz Original Interior Oil Base
* Latex Paint: Behr Premium Plus Paint & Primer in One
* Epoxy: Rust-Oleum Appliance Epoxy
* Varnish: Rust-Oleum Marine Coatings Spar Varnish
* Oil Paint: Glidden Trim, Door, & Furniture
* Polyurethane: Varathane Polyurethane Semi Gloss Interior

| Table 5‑33: Paint and Coating Removal Performance Test Results | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | Type of Stripper | Mixed Panel | Epoxy Panel | Varnish Panel |
| Columbia Coatings | Rapid Strip Liquid | Fast acting | Not tested | Not tested | Not tested |
| Benco | B17 | Fast acting | Not tested | Not tested | Not tested |
| Sunnyside | Aqua Strip | Slow acting | Not tested | Not tested | Not tested |
| EZ Strip | Max Strip Paint and Varnish Stripper | Slow acting | Not tested | Not tested | Not tested |
| W.M. Barr | Jasco Premium Paint & Epoxy Remover | Fast acting | Similar formula to Kwik Strip | Similar formula to Kwik Strip | Similar formula to Kwik Strip |
| W.M. Barr | Citristrip | Slow acting | 3 – 4 hours | 4 – 5 hours | 4 – 5 hours |
| W.M. Barr | Green Paint & Varnish Stripper | Slow acting | 4 – 5 hours | 6 – 7 hours | 5 – 6 hours |
| W.M. Barr | Klean Strip Premium | Fast acting | Similar formula to Kwik Strip | Similar formula to Kwik Strip | Similar formula to Kwik Strip |
| W.M. Barr | Klean Strip Premium – CA formula | Fast acting | Not tested | Not tested | Not tested |
| W.M. Barr | Kwik Strip | Fast acting | > 35 minutes | > 30 minutes | < 32 minutes |
| Dumond Chemicals | Smart Strip | Slow acting | 5 – 6 hours | 5 – 6 hours | 5 – 6 hours |
| Dumond Chemicals | Safe 'n Easy Citrus Paint & Varnish Remover Gel | Slow acting | Not tested | Not tested | Not tested |
| Sunnyside | 2 Minute Remover | Fast acting | > 35 minutes | < 30 minutes | < 32 minutes |
| Sunnyside | High Speed Ready Strip | Slow acting | 3 – 4 hours | 4 – 5 hours | 3 – 4 hours |
| Super Remover | New Generation | Fast acting | < 35 minutes | < 30 minutes | < 32 minutes |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

### Pricing and Customer Reviews

The pricing and customer reviewer information was accessed on publicly available websites during June and July 2021. The results are summarized in Table 5‑34. To assist in comparing prices across various products and product sizes, the prices were normalized to price per quart. All prices were found for quart-sized containers except for the Rapid Strip Liquid product, which was available in 5-gallon containers.

Table 5‑34 provides a representative, but not exhaustive, listing of commercially available paint and coating removal products, including the supplier name, product name, URL for product information, customer reviews, and pricing information. The paint and coating removal products with methylene chloride and NMP had a price range of $8.75 (Rapid Strip Liquid with methylene chloride) to $27.99 (Aquastrip with NMP per quart. Online pricing was not found for the Benco B17 product. The price range for the products without methylene chloride was $9.47 to $19.95 per quart.

The TURI had previously conducted a review of retail online and store pricing for various coating removal products during the 6-month time period from September 2018 through February 2019. This review was conducted before many of the major retailers implemented their voluntary ban of products containing methylene chloride and NMP. At the time of this study, the price range for fifteen products containing methylene chloride was $8.97 to $18.93 per quart ([TURI 2020](#_ENREF_68)).

There is considerable overlap in price range for paint and coating removal products with and without methylene chloride and NMP. This considerable overlap occurred during both the time period from September 2018 through February 2019, as well as the time period from June to July 2021.

The overall consumer ratings for paint and coating removal products are lower than other product categories. This may be attributable to the wide variety of coating removal applications including different coating types, number of coating layers, and different substrate materials. The paint and coating removal products with methylene chloride and NMP had consumer ratings for only one product (Aquastrip with NMP) which had a rating of 3.8 stars. The consumer rating range for the products without methylene chloride and NMP was 2.5 stars (Green Paint & Varnish Stripper) to 4.2 stars (Kwik Strip).

| Table 5‑34: Pricing and customer review information for paint and coating removal products based on manufacturer and retailer web pages | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | Retail information | Price per ounce | Customer rating | Customer reviews |
| Columbia Coatings | Rapid Strip Liquid | <https://www.columbiacoatings.com/RSL-30.aspx>  Available 5, 30, and 55 gallons | $0.27 | No reviews yet | None |
| Benco | B17 | No online pricing or reviews found | Not found | Not found | Not found |
| Sunnyside | Aqua Strip | <https://www.westmarine.com/paint-remover> | $0.87 | 3.8 | 17 |
| EZ Strip | Max Strip Paint and Varnish Stripper | <https://www.amazon.com/MAX-Strip-Paint-Varnish-Stripper/dp/B07WNKGK69> | $0.30 | 3.9 | 666 |
| W.M. Barr | Jasco Premium Paint & Epoxy Remover | <https://www.homedepot.com/p/Jasco-1-qt-Premium-Paint-and-Epoxy-Remover-QJPR501/308267701> | $0.53 | 3.9 | 568 |
| W.M. Barr | Citristrip | <https://www.homedepot.com/p/Citristrip-1-qt-Safer-Paint-and-Varnish-Stripping-Gel-Non-NMP-QCSG801/307416109> | $0.41 | 3.8 | 1,016 |
| W.M. Barr | Green Paint & Varnish Stripper | <https://www.homedepot.com/p/Klean-Strip-Green-1-qt-Paint-and-Varnish-Stripper-QKGS75023/307415730> | $0.30 | 2.5 | 236 |
| W.M. Barr | Klean Strip Premium | <https://www.homedepot.com/s/klean%20strip> | $0.47 | 3.9 | 339 |
| W.M. Barr | Klean Strip Premium – CA formula | <https://www.homedepot.com/p/Klean-Strip-1-qt-Premium-Paint-Remover-and-Stripper-CA-Formula-QKPS301SC/307995062> | $0.41 | 3.2 | 100 |
| W.M. Barr | Kwik Strip | <https://www.lowes.com/pd/Klean-Strip-Kwik-Paint-and-Varnish-Stripper-1-qt/1000659649> | $0.47 | 4.2 | 173 |
| Dumond Chemicals | Smart Strip Advanced | <https://www.amazon.com/Dumond-Chemicals-Smart-Advanced-Remover/dp/B001PCVKLK> | $0.56 | 4.1 | 2,004 |
| Dumond Chemicals | Safe 'n Easy Citrus Paint & Varnish Remover Gel | <https://www.amazon.com/Safe-Easy-Varnish-Hazardous-Non-Toxic/dp/B08PHVJNDJ> | $0.59 | 4.1 | 332 |
| Sunnyside | 2 Minute Remover | <https://www.amazon.com/Sunnyside-634G1-2-Minute-Remover-Advanced/dp/B07NNTTT63> | $0.59 | 3.8 | 754 |
| Sunnyside | High Speed Ready Strip | <https://www.amazon.com/Sunnyside-Hi-Speed-Ready-Strip-Varnish-68532/dp/B003KILWFQ> | $0.31 | 4.0 | 1,685 |
| Super Remover | New Generation | <https://www.amazon.com/Paint-Stripper-Quart-Remover-Generation/dp/B07M8DGFQ4> | $0.62 | 4.1 | 278 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

### Conclusion

EPA did not find barriers to pricing, customer satisfaction, coating removal performance, or VOC content that may be caused by restricting the use of methylene chloride in this product category. Therefore, there are technological and economically feasible alternatives in the marketplace. For fire safety, the restriction of methylene chloride in this product category is met by products with very high flash points, or products with evaporation barriers that restrict vapor generation.

## Adhesive and Caulk Remover

Adhesive removal products are used for the removal of many types of adhesives and glues such as flooring adhesives, gasket adhesives, mastics, tape adhesives, and contact cement. Caulk removal products are used for the removal of many types of caulks and sealants such as acrylic latex caulk, elastomeric sealants, and silicone sealants. Most products are marketed as an adhesive remover or a caulk remover; however, there are instances in which a single product is marketed as both an adhesive remover and a caulk remover. An example is as the Goo Gone Pro Power Goo and Adhesive Remover.

Adhesive and caulk remover products are sold to both do-it-yourself retail consumers and commercial customers in packaging sizes ranging from 1 ounce to 55-gallon drums. The removal products can be considered general purpose or specialty. General purpose adhesive or caulk removers are used for a wide range of coatings, substrate materials, and applications. Specific purpose removers are designed for specific applications. For example, the CRC Gasket Remover product is marketed for removal of gasket adhesives and gasket materials.

### Solvent Ingredients

Adhesive and caulk remover products contain various types of solvents. methylene chloride and NMP are used as solvents in some adhesive and caulk remover products. However, with the recent regulations in place in Europe and the United States that restrict the use of methylene chloride in coating removal products and voluntary bans by U.S. retailers restricting the use of NMP coating removal products, there has been a transition towards more methylene chloride-free and NMP-free formulations. For example, WM Barr, a major supplier of adhesive removal products, has discontinued the sale of a methylene chloride based adhesive removal product (Klean Strip Adhesive Remover) and now sells a non-methylene chloride-based product. A WM Barr Citrus Strip Adhesive Remover product containing NMP is listed for sale on the [www.toolboxsupply.com](http://www.toolboxsupply.com) website; however, it is listed as out of stock and the product cannot be found on the manufacturer's (WM Barr) website. It appears that this product may also be discontinued.

Table 5‑35 provides a listing of some commercially available adhesive and caulk removal products and the primary solvent ingredients. Table 5‑35 also indicates whether the product is marketed as an adhesive remover, caulk remover, or both. One adhesive removal product containing methylene chloride was found for sale by a United States based company (Savogran) that contained two co-solvents: methanol and toluene. One adhesive removal product containing methylene chloride was found for sale from a United Kingdom based company (Magic Bullet). Four adhesive removal products were found that contained NMP: Blue Bear, CRC Industries Gasket Remover, 3M SkyRestore, and Loctite SF 75326. Methylene chloride and NMPwere not found as ingredients in any caulk removal products. A variety of other solvents are used in adhesive and caulk removal products. Examples include acetone, petroleum distillates, 1,3 dioxolane, methyl acetate, benzyl alcohol, and dimethyl glutarate. Ten products that do not contain methylene chloride or NMPare listed in Table 5‑35.

| Table 5‑35: Safety data sheets and solvent ingredients with concentrations 5% or higher for reviewed adhesive and caulk removal products | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Supplier | Product | SDS | SDS date | Solvent ingredients | Concentration (%) | Caulk removal | Adhesive removal |
| Magic Bullet | Strong Adhesive & Residue Remover (ARC) | <http://www.magicbulletproducts.com/media/catalog/product/pdf/ARC_MSDS_1.pdf> | 26 March 2007 | Methylene Chloride | >50 | No | Yes |
| Methanol | 5 - 10 |
| Savogran | Superstrip | <https://savogran.com/pdfs/SuperStrip_MS.pdf> | 11 April 2019 | Methylene Chloride | 80 - 85 | No | Yes |
| Methanol | 5 - 10 |
| Toluene | 5 - 10 |
| Franmar | Blue Bear 540 PM Polyurethane Adhesive Remover | <https://www.greenbuildingsupply.com/core/media/media.nl?id=1326187&c=772072&h=24b45f797574cf55a43f&_xt=.pdf> | 6 March 2015 | NMP | 41 | No | Yes |
| Dibasic ester | 40 - 45 |
| Soy ester | 15 - 20 |
| Henkel | Loctite SF 7526 Cleanup Solvent | <https://www.grainger.ca/msds-search/getPDF/51572668> | 13 March 2017 | NMP | 90 - 100 | No | Yes |
| CRC | Gasket Remover, Model Number: 03017 | http://complyplus.grainger.com/grainger/msds.asp?sheetid=4239215#sec2 | 12 September 2017 | Acetone | 50 - 60 | No | Acetone |
| Liquefied petroleum gas | 20 - 30 |
| NMP | 10 - 20 |
| 3M | 3M 38984 Specialty Adhesive Remover | <https://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn_zu8l00xMYtUoY_Gov70k17zHvu9lxtD7SSSSSS--> | 04 January 2021 | Acetone | 15 - 40 | No | Yes |
| Xylene | 15 - 40 |
| Light petroleum distillate | <35 |
| Hydrotreated light naphtha | <35 |
| Solvent naphtha (petroleum), light aliphatic | <35 |
| Ethylbenzene | 13-Mar |
| 3M | SkyRestore Gel By Elixair Cured | <https://p11.secure.hostingprod.com/@site.skygeek.com/ssl/MSDS/aerosafe-lm307-5-elixair-lm-307-1-skyrestore-sealant-adhesive-solvent-thick-5-0-liter.pdf> | 21 August 2014 | 2-Methoxy-1-methylethyl acetate | 40 - 60 | Yes | Yes |
| 1-methyl-2-pyrrolidone | 20 - 30 |
| 1-Butoxypropan-2-ol | 8 - 20 |
| DAP | DAP Caulk B Gone Latex Caulk Remover | https://www.dap.com/media/3398/7718201english.pdf | 5 March 2019 | Dimethyl glutarate | 10 - 30 | Yes | No |
| Dimethyl succinate | 5 - 10 |
| Dimethyl adipate | 1 - 5 |
| Goo Gone | Original Goo and Adhesive Remover | https://googone.com/sds | 29 July 2019 | Petroleum distillates, hydrotreated light | 60 - 100 | No | Yes |
| d-Limonene | 1 - 5 |
| Goo Gone | Pro Power Goo and Adhesive Remover | https://images.homedepot-static.com/catalog/pdfImages/81/81da06d1-f08e-48f7-8402-84b1115d86dd.pdf | 11 October 2017 | Petroleum distillates, hydrotreated light | 60 - 100 | Yes | Yes |
| d-Limonene | 1 - 5 |
| Goo Gone | Caulk Remover | <https://googone.com/mr_sds/data/goo-gone-caulk-remover-english.pdf> | 8 July 2016 | Acetone | 7 - 13 | Yes | No |
| Benzyl alcohol | 1 - 5 |
| Roberts | 5505 Urethane Adhesive Remover | <https://images.homedepot-static.com/catalog/pdfImages/99/99d91d9d-9a22-400c-9703-56f28a42cb53.pdf> | 4 February 2014 | Benzyl alcohol | 30 - 40 | No | Yes |
| dimethyl gluturate | 40 - 45 |
| glycolether | 7 - 15 |
| Rustoleum | Krud Kutter Caulk Remover | <https://images.homedepot-static.com/catalog/pdfImages/df/dff0255d-8046-4ae4-aa77-bc342508c930.pdf> | 5 August 2020 | Acetone | 2.5 - 10 | Yes | No |
| Super Rem-over | Adhesive Remover | <https://www.superremover.com/wp-content/uploads/2019/08/SuperRemoverNG_for-GLUE_CAN_EN_SDS_Nov-2018.pdf> | 12 October 2018 | Methyl acetate | 40 - 70 | No | Yes |
| 1,3-Dioxolane | 20 - 22 |
| Un-Du | Un-Du Adhesive Remover | <https://www.un-du.com/un-du_SDS_AUNDUXX-004-004.pdf> | 6 August 2015 | Naphtha, hydrotreated light | 100 | No | Yes |
| WM Barr | Klean Strip Adhesive Remover Non-Methylene Chloride Formula | <https://images.homedepot-static.com/catalog/pdfImages/96/96deca8f-c908-4b08-98d7-619feb7e3c6c.pdf> | 11 December 2018 | Diethylene glycol monobutyl ether | 15 - 40 | No | Yes |
| Benzyl alcohol | 10 - 30 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | | | |

Table 5‑36 shows the anticipated, approximate market share percentage of primary solvents used in adhesive and caulk removers, estimated using the chemical ranking procedure. If restrictions were implemented for methylene chloride, then it is anticipated that petroleum distillates and water would be the most prevalent solvents used in replacement products. There are several alternative products that contain Greenscreen Benchmark 1 solvents such as xylene, ethyl benzene, and methanol.[[11]](#footnote-13) These Benchmark 1 solvents are potential regrettable substitutions for methylene chloride. There are numerous commercially available alternative products for adhesive and caulk removal products without Benchmark 1 solvents.

| Table 5‑36: Estimated percentage share of solvent ingredients for reviewed adhesive and caulk removal products | | |
| --- | --- | --- |
| Solvent | Current market share | Projections for replacement products |
| Methylene Chloride | 11% | 0% |
| NMP | 11% | 0% |
| Petroleum distillates | 23% | 29% |
| Water | 18% | 22% |
| Dimethyl glutarate | 6% | 8% |
| Acetone | 6% | 8% |
| Methyl acetate | 5% | 7% |
| Benzyl alcohol | 5% | 6% |
| Glycol ether | 3% | 4% |
| 2-methoxy-1-methylethyl acetate | 3% | 4% |
| Other solvents | 8% | 12% |
| Notes: The figures shown here are based on a proxy chemical ranking procedure, which draws upon factors including concentration in the product and availability and quality of product reviews. Orange shading indicates methylene chloride. Grey shading indicates another one of the first 10 TSCA work plan chemicals. Given the regulatory uncertainty while EPA considers risk management options for these chemicals, this analysis assumes any of the first 10 TSCA chemicals would not be adopted as alternative for methylene chloride while this regulatory uncertainty exists. | | |

### Volatile Organic Compounds (VOC) Content

VOC regulations for adhesive removal products are present at the state level, but not at the federal level. The VOC regulations are not present in all states but are for states covered by OTC and a few other states such as California. Compliance with U.S. state regulations requires VOC content less than 20% for general purpose adhesive removal products. For specialty adhesive removal products, the VOC content must be less than 5% for floor or wall covering adhesive removers, less than 50% for gasket or thread locking adhesive removers, and less than 70% for specialty adhesive removers ([ISSA 2019](#_ENREF_34)). VOC requirements for caulk removal products were not found at the state or federal level.

| Table 5‑37: VOC content for adhesive and caulk removers based on information in SDSs or technical data sheets | | |
| --- | --- | --- |
| Supplier | Product | VOC (% weight, g/L) |
| Magic Bullet | Strong Adhesive & Residue Remover (ARC) | Not provided |
| Savogran | Super-strip | 15% |
| Franmar | Blue Bear 540 PM Polyurethane Adhesive Remover | 49.5% |
| Henkel | Loctite SF 7526 Cleanup Solvent | Not found |
| CRC | Gasket Remover, Model Number: 03017 | 47.5% |
| 3M | 3M 38984 Specialty Adhesive Remover | 820 g/l |
| 3M | SkyRestore Gel by Elixair Cured | 956.8 g/l |
| DAP | DAP Caulk B Gone Latex Caulk Remover | 34.5% |
| Goo Gone | Original Goo and Adhesive Remover | Not found |
| Goo Gone | Pro Power Goo and Adhesive Remover | Not provided |
| Goo Gone | Caulk Remover | Not provided |
| Roberts | 5505 Urethane Adhesive Remover | Not provided |
| Rust-oleum | Krud Kutter Caulk Remover | 727 g/l |
| Super Remover | Adhesive Remover | Not provided |
| Un-Du | Un-Du Adhesive Remover | Not provided |
| WM Barr | Klean Strip Adhesive Remover Non-DCM Formula | 0.1% |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals | | |

Several adhesive removal products appear to be VOC compliant with state regulations. For example, the 3M 38984 Specialty Adhesive Remover product safety data sheet states that the product contains 15% to 40% acetone and the product VOC content is listed as 68%. This reduced VOC content is a result of the product being composed of a significant percentage of a VOC exempt solvent. Since this product is a specialty adhesive removal product, it appears that this product is VOC content compliant with the following requirement: "less than 70% for specialty adhesive removers." However, some product safety data sheets do not list any VOC-exempt solvent ingredients or list the product VOC content. These products are either not VOC compliant‑ or possibly contain water or other VOC-exempt solvents that are not required to be listed on a Safety Data Sheet. The Un-Du Adhesive Remover contains 100% naphtha and does not provide the product VOC content. It is not clear how this product will be VOC content compliant since it contains 100% of a solvent that is not VOC exempt.

If methylene chloride was restricted from adhesive removal products, there should not be any barriers to attaining VOC compliant products since several methylene chloride-free commercially available products already are using VOC exempt solvents such as acetone and methyl acetate.

### Fire Safety

Methylene chloride is non-flammable, and NMP has a very high flash point of 196 °F. Therefore, adhesive and caulk removal products using high concentrations of methylene chloride or NMP are typically non-flammable. Several solvents used as alternatives to methylene chloride in adhesive and caulk removal products also have high flash points and their use can result in products that are non-flammable (flash point greater than 150 F°). For example, the Goo Gone Original Goo and Adhesive Remover has a flash point of 185 °F, the Goo Gone Pro Power Goo and Adhesive Remover has a flash point of 185 °F, the Klean Strip Adhesive Remover Non-methylene chloride Formula has a flash point of greater than 212 °F, and the DAP Caulk B Gone Latex Caulk Remover is listed as non-flammable, according to the Safety Data Sheet for each product.

| Table 5‑38: Flash point and flammability ratings for adhesive and caulk removers based on information in SDSs or technical data sheets | | | |
| --- | --- | --- | --- |
| Supplier | Product | Flash point | Flammability rating |
| Magic Bullet | Strong Adhesive & Residue Remover (ARC) | Not found | Not found |
| Savogran | Super-strip | None | Non-flammable |
| Franmar | Blue Bear 540 PM Polyurethane Adhesive Remover | >200° F | Non-flammable |
| Henkel | Loctite SF 7526 Cleanup Solvent | Not found | Not found |
| CRC | Gasket Remover, Model Number: 03017 | 56° F | Flammable |
| 3M | 3M 38984 Specialty Adhesive Remover | - 1° F | Extremely Flammable |
| 3M | SkyRestore Gel by Elixair Cured | 132.8° F | Combustible |
| DAP | DAP Caulk B Gone Latex Caulk Remover | 212° F | Non-flammable |
| Goo Gone | Original Goo and Adhesive Remover | Not found | Not found |
| Goo Gone | Pro Power Goo and Adhesive Remover | 185° F | Non-flammable |
| Goo Gone | Caulk Remover | 78° F | Flammable |
| Roberts | 5505 Urethane Adhesive Remover | > 212° F | Non-flammable |
| Rust-oleum | Krud Kutter Caulk Remover | 63° F | Flammable |
| Super Remover | Adhesive Remover | 23° F | Flammable |
| Un-Du | Un-Du Adhesive Remover | 25° F | Flammable |
| WM Barr | Klean Strip Adhesive Remover Non-DCM Formula | 212° F | Non-flammable |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals | | | |

Since there are numerous adhesive and caulk removal products available that are non-flammable, there should not be any barriers to replace methylene chloride based products based upon fire safety requirements.

### Removal Time

The adhesive and caulk remover products must either dissolve the target material or sufficiently soften the target material so that it can be removed with a simple tool such as a plastic scraper. Removal time is the amount of time required for the target material to either dissolve or be softened. The recommended times for removal of adhesives/caulk vary with the product and the type of material being removed. For example, the Goo Gone Caulk Remover product recommends a dwell time of 60 seconds to remove wet sealants and a dwell time of 2 to 3 minutes to remove dry sealants. This analysis section will use results from a 2020 performance study and the Hansen Solubility Parameters theory to represent removal time for adhesive and caulk remover products.

A performance study for adhesive removal products was conducted by TURI ([2020](#_ENREF_68)). For this evaluation, the Roberts 67000 Superior Indoor/Outdoor Carpet Adhesive product was used for all tests. The carpet adhesive was evenly spread over a wood surface and allowed to cure. Eighteen different coating removal products were tested to determine how long each coating removal product would take to remove the carpet adhesive from the wood substrate. The four coating removal products containing methylene chloride were effective at removal of the carpet adhesive for times varying between 30 to 90 minutes. The most effective of the methylene chloride products was the WM Barr Klean Strip Premium. The one product available in the U.S. marketed as an adhesive remover that contains methylene chloride (SuperStrip) was effective at removal of the carpet adhesive between 60 to 90 minutes. No products containing NMP were tested in the TURI report, so adhesive removal time for NMP-based products was not determined. Also, removal times for NMP-based products were not found in label directions. Based upon 1) the superior performance of methylene chloride -based products over NMP-based products for faster removal time for oil paint, latex paint, epoxy, lacquer, shellac, and polyurethane in the TURI report and 2) the much larger molecular volume of NMP as compared to methylene chloride, it is anticipated that methylene chloride-based products would also have faster removal time than NMP based products for adhesives.

The fourteen different coating removal products without methylene chloride or NMP were effective at removal of the carpet adhesive for times varying between 60 minutes to greater than 8 hours. There is overlap between the removal time performance of the products containing methylene chloride and the products with no methylene chloride. Therefore, if coating removal time was an important factor for customer satisfaction, then there are non-methylene chloride products available to meet this requirement for the specific carpet adhesive tested.

For the purposes of this review, another method to assess removal time performance was identified. This method uses the Hansen Solubility Parameters (HSP) theory (See Appendix B) as a surrogate to estimate contaminant removal time. Since the WM Barr Klean Strip Premium with methylene chloride product had the best adhesive removal time performance in the TURI 2020 paper, the HSP value of 16.9, 7.6, 7.9 for this product was used as the target. This HSP value was calculated based upon the WM Barr safety data sheet dated May 1, 2019. Table 10 provides a listing of the adhesive products, HSP values for each product, and the HSP distance to the WM Barr Klean Strip Premium with methylene chloride product. Based upon previous research, the assumption is that the lower the HSP distance to the WM Barr Klean Strip Premium product, the better the removal performance.

| Table 5‑39: Product HSP Values and HSP Distance | | | |
| --- | --- | --- | --- |
| Supplier | Product | HSP value | HSP distance to Klean Strip Premium with Methylene Chloride  (16.9, 7.6, 7.9) |
| Magic Bullet | Strong Adhesive & Residue Remover' (ARC) | 16.8, 7.8, 8.6 | 0.8 |
| Savogran | Super-strip | 16.8, 7.5, 8.4 | 0.6 |
| Franmar | Blue Bear 540 PM Polyurethane Adhesive Remover | 16.8, 8.9, 8.6 | 1.5 |
| Henkel | Loctite SF 7526 Cleanup Solvent | 16.8, 7.5, 8.4 | 0.6 |
| CRC | Gasket Remover, Model Number:03017 | 16.1, 9.3, 6.0 | 3.0 |
| 3M | 3M 38984 Specialty Adhesive Remover | 15.9, 2.3, 1.9 | 8.3 |
| 3M | SkyRestore Gel By Elixair Cured | 16.2, 7.1, 9.1 | 1.9 |
| DAP | DAP Caulk B Gone Latex Caulk Remover | 15.0, 11.8, 26.6 | 19.5 |
| Goo Gone | Original Goo and Adhesive Remover | 16.3, 0.1, 0.2 | 10.8 |
| Goo Gone | Pro Power Goo and Adhesive Remover | 16.3, 0.1, 0.2 | 10.8 |
| Goo Gone | Caulk Remover | 15.5, 15.0, 37.1 | 30.2 |
| Roberts | 5505 Urethane Adhesive remover | 17.1, 6.9, 10.8 | 3.0 |
| Rust-oleum | Krud Kutter Caulk Remover | 15.5, 15.4, 38.8 | 32.0 |
| Super Remover | Adhesive Remover | 16.6, 8.9, 8.5 | 1.6 |
| Un-Du | Un-Du Adhesive Remover | 15.5, 0, 0 | 11.3 |
| WM Barr | Klean Strip Adhesive Remover Non=DCM Formula | 16.7, 9.2, 21.0 | 13.2 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals | | | |

Four of the products listed in Table 5‑39 were also included in the TURI testing. For each of these four products, Table 5‑40 provides the performance testing results and the calculated HSP distance to the Klean Strip Premium with methylene chloride.

| Table 5‑40: Relationship between HSP Distance and Removal Time from Performance Tests | | | |
| --- | --- | --- | --- |
| Supplier | Product | HSP distance to Klean Strip Premium with DCM  (16.9, 7.6, 7.9) | Removal time from performance test |
| WM Barr | Klean Strip Premium with methylene chloride | 0 | 30 – 60 minutes |
| Super Remover | Adhesive Remover | 1.6 | 60 – 90 minutes |
| Goo Gone | Pro Power Goo and Adhesive Remover | 10.8 | 3 – 4 hours |
| WM Barr | Klean Strip Adhesive Remover Non methylene chloride Formula | 13.2 | 4 – 5 hours |

Based upon the data provided in Table 5‑40, the performance test results seem to be correlated with the HSP distance where the greater the HSP distance from the Klean Strip Premium with methylene chloride product, the longer the removal time. Therefore, the HSP distance appears to be a good surrogate for the removal speed for the different adhesive removal products.

The importance of coating removal time to customers can be evaluated by using publicly available customer satisfaction responses for a removal product. For example, Goo Gone Pro Power Goo and Adhesive Remover was tested by TURI and was effective at removal of the carpet adhesive between 3 to 4 hours. The Goo Gone Pro Power Goo and Adhesive Remover product does not list any specific removal time requirements within the "Directions" section of the product label. The only reference to removal time on the product label is as follows: "Allow formula time to saturate problem area as needed." The Goo Gone Pro Power Goo and Adhesive Remover product is sold on Amazon in 32-ounce packaging and has 505 customer reviews with an average rating of 4.7 out of 5 stars, which indicates a high level of customer satisfaction. There are also 50 questions and answers posted on Amazon for this product. Using the search term "time," there were no customer reviews or questions/answers that addressed the time required for the product to work. Amazon customers are most likely to be retail Do-It-Yourself (DIY) consumers. Therefore, it seems that it is more important for DIY customers whether the product ultimately worked or not for a given application, rather than the exact amount of time required for it to work. However, removal time could potentially be more of a concern for commercial users.

In general, the faster the adhesive and caulk removal product works, the faster the removal project will be finished. However, there does not always seem to be a clear customer expectation for the duration of time for the removal products to work.

There are adhesive removal products commercially available that demonstrate a coating removal performance with comparable removal speed methylene chloride-based products. If methylene chloride were restricted from adhesive removal products, there should not be barriers to substitution due to removal time. Since NMP adhesive removal time test data is not available, it is not known how removal times with NMP products compare with NMP-free products. However, since alternative products have comparable removal speeds as methylene chloride-based products and methylene chloride is expected to have a faster removal time than NMP in most instances, this is not expected to be a barrier.

### No Damage to Substrate Material

The product should not stain, discolor, or alter the substrate, or corrode a metal substrate. In general, the adhesive and caulk removal products address this potential issue by listing the substrate materials that are safe to use with the product. For example, the product label for the adhesive remover that contains methylene chloride (SuperStrip) states that it can be used for wood, metal, and masonry substrates. Some products provide additional information by listing the substrate materials that are safe to use with the product and listing the substrate materials that should be avoided with the product. For example, Goo Gone Pro Power Goo and Adhesive Remover product label clearly states a listing of "Surface Safe" substrates such as carpet and clothing, and a listing of "Do Not Use On" substrates such as silk, leather, and rubber. If methylene chloride and NMP were restricted from adhesive removal products, there should not be any barriers to replace the methylene chloride product since wood, metal, and masonry substrates are also compatible with many commercially available methylene chloride-free adhesive removal products. There was no special substrate identified where methylene chloride and NMP could be used without substrate damage and the alternatives could not be safely used.

### Irritating Odor

Adhesive and caulk removal products that emit strong irritating odors may be unpleasant to the user. Each solvent has a concentration level that becomes irritating to humans. Table 5‑41 provides a listing of irritating concentration levels for common solvents and solvents used in adhesive and caulk removal products ([Ruth 1986](#_ENREF_60)).

| Table 5‑41: Irritating Concentrations of Solvents | |
| --- | --- |
| Solvent | Irritating concentration (mg/m3) |
| Hydrogen sulfide | 14 |
| Acetic acid | 25 |
| Formic acid | 27 |
| Naphthalene | 75 |
| Xylene | 435 |
| Acetone | 475 |
| Toluene | 750 |
| Ethyl benzene | 870 |
| Cyclohexane | 1,050 |
| Methylene Chloride | 8,280 |
| Methanol | 22,875 |
| Methyl acetate | 30,497 |
| Note: Orange shading indicates methylene chloride. | |

Solvents with low irritating concentration levels (such as below 100 mg/m3) are often considered strong and offensive, such as hydrogen sulfide, acetic acid, and formic acid. The one adhesive removal product (SuperStrip) containing methylene chloride available in the United States has the following irritating concentration levels for its solvents: methylene chloride (8,280 mg/m3) methanol (22,875 mg/m3) and toluene (750 mg/m3). Since toluene has the lowest irritating concentration level, it would be the solvent in the product with the greatest potential to create unpleasant odors to the consumer. The irritating concentration level for NMP could not be found. However, the NMP-based adhesive removal products typically have co-solvents such as acetone and xylene that have measured irritating concentration levels.

The Goo Gone Original Goo and Adhesive Remover product contains petroleum distillates and D-limonene. The irritating concentration level for the specific petroleum distillate used in this product was not found. However, the irritating concentration level for another petroleum distillate (naphthalene) is 75 mg/m3 indicating that other petroleum distillates may have strong, offensive odors. The Goo Gone Original Goo and Adhesive Remover product is sold on Amazon and has 8,945 customer reviews (as of December 14, 2020). Using the search term "odor," there were several customer reviews that provided negative descriptions of the odor including: "odor is strong," "unpleasant odor," "very potent odor," and "potent odor."

The irritating concentration level was not found for many solvents used in adhesive and caulk removal products such as 1, 3 dioxolane, dimethyl glutarate, dimethyl succinate, dimethyl adipate, and benzyl alcohol. However, the irritating concentration level was found for many other solvents used in adhesive and caulk removal products such as xylene, acetone, ethyl benzene, cyclohexane, and methyl acetate. The range of irritating concentration levels for these solvents was xylene (435 mg/m3) to methyl acetate (30,497 mg/m3). Products containing these solvents would provide a comparable odor level to the methylene chloride based product containing toluene and methanol or NMP products containing acetone or xylene. It should be noted that products containing hazardous solvents should be used with proper personal protective equipment. Further, the unpleasant odor of hazardous solvents can serve as a warning of inhalation exposure to the hazardous solvent. Therefore, if methylene chloride and NMP were restricted from adhesive removal products, there should not be any barriers to replace the methylene chloride product based upon odor requirements.

### Pricing and Customer Reviews

Retail price can be a factor for market acceptance of adhesive and caulk removal products. These products are available in a variety of sizes and price levels. The prices for these products are listed in Table 13. This pricing information was accessed on publicly available websites during December 2020 and April 2021. To assist in comparing prices across various products and product sizes, the prices were normalized to price per ounce.

| Table 5‑42: Commercially Available Adhesive and Caulk Removal Products | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | Product Information | Price per ounce | Customer ratings (out of 5) | Number of customer reviews |
| Magic Bullet | Strong Adhesive & Residue Remover (ARC) | <http://www.magicbulletproducts.com/strong-adhesive-residue-remover> | $0.63 | None | None |
| Savogran | Super-strip | <https://www.doitbest.com/shop/paint-and-painting-supplies/strippers-and-removers/paint-varnish-and-stain-removers/paint-and-varnish-stripper/savogran-superstrip-methylene-chloride-free-stripper?SKU=775423> | $0.44 | None | None |
| Franmar | Blue Bear 540 PM Polyurethane Adhesive Remover | https://www.greenbuildingsupply.com/All-Products/Paints-Coatings-Strippers-Thinners/FranMar-540PM-Polyurethane-Adhesive-Remover-1-Gallon | $0.53 | None | None |
| Henkel | Loctite SF 7526 Cleanup Solvent | https://www.grainger.ca/en/product/CLEANER-SF-753-1-FL-OZ/p/LCT75326 | $34.08 | None | None |
| CRC | Gasket Remover, Model Number: 03017 | https://www.grainger.com/product/CRC-Remover-5YK56 | $0.98 | None | None |
| 3M | 3M 38984 Specialty Adhesive Remover | <https://www.walmart.com/ip/3M-38984-Specialty-Adhesive-Remover-Quart/33276354> | $1.29 | 5 | 2 |
| 3M | SkyRestore Gel By Elixair Cured | <https://www.skygeek.com/elixair-skyrestore-sealant-and-adhesive-solvent.html> | $3.91 | None | None |
| DAP | DAP Caulk B Gone Latex Caulk Remover | <https://www.dap.com/products-projects/product-categories/caulks-sealants/specialty/caulk-be-gone/>  <https://www.acehardware.com/departments/paint-and-supplies/chemicals-and-cleaners/adhesive-removers/1392430> | $1.20 | 4.0 | 4 |
| Goo Gone | Original Goo and Adhesive Remover | <https://www.amazon.com/Goo-Gone-Original-Liquid-Adhesive/dp/B00006IBNJ?th=1> | $0.87 | 4.6 | 8,554 |
| Goo Gone | Pro Power Goo and Adhesive Remover | <https://www.homedepot.com/p/Goo-Gone-24-oz-Pro-Power-Spray-Gel-2080/205188196>  <https://images.homedepot-static.com/catalog/pdfImages/07/077ae9d7-8eb0-4281-a2b6-9ad09a3b7f32.pdf> | $0.33 | 4.1 | 188 |
| Goo Gone | Caulk Remover | <https://googone.com/caulk-remover>  <https://www.walmart.com/ip/Goo-Gone-Liquid-Caulk-Remover-14-oz/583493405> | $1.14 | 3.3 | 4 |
| Roberts | 5505 Urethane Adhesive Remover | <https://www.homedepot.com/p/Roberts-24-oz-Urethane-Multipurpose-and-Specialty-Adhesive-Remover-in-Ready-to-Use-Bottle-R5505/205051450> | $0.83 | 3.6 | 52 |
| Rust-oleum | Krud Kutter Caulk Remover | <https://www.homedepot.com/p/Krud-Kutter-24-oz-Caulk-Remover-336250/305457505> | $0.33 | 2.9 | 244 |
| Super Remover | Adhesive Remover | <https://www.amazon.com/Adhesive-Stripper-Quart-Super-Remover/dp/B07S52HXCM> | $0.69 | 4.0 | 176 |
| Un-Du | Un-Du Adhesive Remover | <https://www.walmart.com/ip/Un-Du-Adhesive-Remover-4-oz/21997597> | $2.62 | 4.6 | 44 |
| WM Barr | Klean Strip Adhesive Remover Non methylene chloride Formula | <https://www.homedepot.com/p/Klean-Strip-1-Gal-Adhesive-Remover-GKAR400/308940933> | $0.31 | 3.1 | 40 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

The two adhesive removal products containing methylene chloride have a price range of $0.44 per ounce (SuperStrip) to $0.63 per ounce (Magic Bullet). The four products containing NMP have a price range of $0.53 per ounce (Blue Bear) to $34.08 per ounce (Loctite). The twelve adhesive and caulk removal products without methylene chloride or NMP have a price range of $0.31 per ounce (Klean Strip) to $2.62 per ounce (Un-do Adhesive Remover). In addition to the Klean Strip product, two other methylene chloride free and NMP-free products have prices below the range of methylene chloride and NMP products: Goo Gone ProPower Goo and Adhesive Remover at $0.33 per ounce, and Krud Kutter Caulk Remover at $0.33 per ounce.

Since several commercially available adhesive and caulk removal products have price levels below the range of products containing methylene chloride, there does not appear to be a barrier due to price for the use of methylene chloride free products.

The products containing methylene chloride did not have any online customer reviews. Customer ratings for alternative products ranged from 2.9 (Krud Kutter Caulk Remover) to 5 (3M 38984 Specialty Adhesive Remover). Although there was no customer rating for the methylene chloride product to compare to, the alternative products ratings suggest several products available have overall high customer satisfaction.

### Conclusion

Based upon this limited evaluation of the current market for adhesive and caulk removal products, it appears that methylene chloride and NMP are not used for caulk removal products and that there are no cost or efficacy barriers to moving away from methylene chloride for adhesive removal products. There is no evidence that suggests restrictions on the use of methylene chloride, NMP, and 1-bromopropane would result in the use of trichloroethylene or perchloroethylene for these types of products, particularly given the increasing regulatory scrutiny for these solvents. Therefore, technologically and economically feasible alternatives are present in the marketplace.

## Lithographic Printing Cleaner

Conventional press washes dissolve inks on lithographic printer rollers, blankets, and other parts in an industrial printer system. These washers are typical sold through business-to-business vendors or third-party contractors for commercial use. Volumes ranged from one gallon to 55-gallon drums. Depending on the product, a business may be required to order multiple gallons per order.

### Solvent Ingredients

The review included one product containing methylene chloride, which was also a rubber rejuvenator, and five products containing alternative solvents including mineral spirits, petroleum distillates/hydrocarbons, toluene, and others. Table 5‑43 shows the list of products reviewed for this analysis and their primary solvent ingredients.

| Table 5‑43: Safety data sheets and solvent ingredients with concentrations 5% or higher for reviewed conventional press wash products | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | SDS | SDS date | Solvent ingredients | Concentration (%) |
| Hurst Chemical Company | 116 Rubber Rejuvenator | <https://www.gwjcompany.com/MSDS/Hurst_Chemical/116.pdf> | 10 September 2018 | Methylene Chloride | 30 - 50 |
| Methyl iso butyl ketone (MIBK) | 5 - 10 |
| Toluene | 5 - 10 |
| Isopropanol | 1 - 5 |
| Tower | I.P. Wash | <https://www.towerproducts.com/assets/files/IP-Wash---2015.pdf> | 1 January 2015 | Aliphatic Hydrocarbon | 50 - 60 |
| Aromatic Hydrocarbon | 40 - 50 |
| D-Limonene | 1 - 10 |
| Tower | Tech Wash-IF | <https://www.towerproducts.com/Tech%20Wash%20IF%20%20%20September%202019.pdf> | 5 September 2019 | Mineral spirits | 60 - 70 |
| Aromatic Hydrocarbon | 25 - 35 |
| 1,2,4-Trimethylbenzene | £12 |
| Tower | Infinity Wash | <https://www.towerproducts.com/assets/files/Infinity-Wash-HMK-1-WM--2015.pdf> | 1 January 2015 | Aliphatic Hydrocarbon | 80 - 100 |
| Varn International | California Wash | <https://kellypaper.com/d/msds/Varn/99291A.pdf> | 25 February 2011 | Hydrotreated Light Distillate (Petroleum) | 60 - 90 |
| Dipropylene Glycol Methyl Ether | 7 - 13 |
| Solvent naphtha (petroleum), light arom. | 1 - 5 |
| Citrus Terpenes | 1 - 5 |
| 1,2,4-Trimethylbenzene | 1 - 5 |
| Varn International | Metering Roller Cleaner | <https://kellypaper.com/d/msds/June-2017-Update/Varn/99291FVarn%20MRC%20Metering%20Roller%20Cleaner%20Gallon.pdf> | 24 August 2015 | Distillates (petroleum), light distillate hydrotreating process, low-boiling | 60 - 100 |
| Note: Orange shaded rows indicate products that contain methylene chloride. | | | | | |

Table 5‑44 shows the anticipated, approximate market share percentage of primary solvents used in products estimated using the chemical ranking procedure. Petroleum distillates appear to be the most prevalent solvent used in this product category. If restrictions were implemented for methylene chloride, then petroleum distillates would continue to be the most prevalent solvent.

There are several solvents used in alternative products that contain Greenscreen Benchmark 1 chemicals such as mineral spirits/Stoddard Solvent and certain petroleum distillates (*e.g.*, CAS # 64742-95-6).[[12]](#footnote-14) These Benchmark 1 solvents are potential regrettable substitutions for methylene chloride. There are numerous commercially available alternative products for conventional press wash products without Benchmark 1 solvents.

| Table 5‑44: Estimated percentage share of solvent ingredients for reviewed conventional press wash products | | |
| --- | --- | --- |
| Solvent | Current market share | Projections for replacement products |
| Methylene Chloride | 14% | 0% |
| Petroleum distillates | 65% | 76% |
| Mineral spirits | 11% | 13% |
| MIBK | 2% | 2% |
| Toluene | 2% | 2% |
| Dipropylene glycol methyl ether | 2% | 2% |
| Other | 4% | 5% |
| Notes: The figures shown here are based on a proxy chemical ranking procedure, which draws upon factors including concentration in the product and availability and quality of product reviews. Orange shading indicates methylene chloride. Given the regulatory uncertainty while EPA considers risk management options for these chemicals, this analysis assumes any of the first 10 TSCA chemicals would not be adopted as alternative for methylene chloride while this regulatory uncertainty exists. | | |

### Volatile Organic Compounds (VOC) Content

VOC information was reviewed in product SDSs and summarized findings are in Table 5‑45. There are state VOC regulatory limits for the use of cleaning in various printer applications. For example, in Massachusetts there is a requirement for cleanup solutions used in offset lithography and letterpress to not exceed 70% VOC ([Mass DEP 2019](#_ENREF_39)). In California, the South Coast Air Quality Management District Rule 1171 sets a VOC limit of 100 g/l for roller wash and blanket wash for lithographic (offset) or letter press printing. This review did not include consideration of factors related to dilution, which may affect VOC compliance.

| Table 5‑45: VOC content for conventional press wash products based on information in SDSs or technical data sheets | | |
| --- | --- | --- |
| Supplier | Product | VOC  (% weight, g/L) |
| Hurst Chemical Company | 116 Rubber Rejuvenator | 557 gm/l or 4.65 lb/gal |
| Tower | I.P. Wash | 99%, 816 g/L |
| Tower | Tech Wash-IF | 99%, 814 g/L |
| Tower | Infinity Wash | 99%, 788 g/L |
| Varn International | California Wash | 6.53 lbs/gal |
| Varn International | Metering Roller Cleaner | 100% by weight, 73.9% by volume, 739 g/L, 6.2 lbs/gal |
| Note: Orange shaded rows indicate products that contain methylene chloride. | | |

### Fire Safety

Flash points and flammability ratings were reviewed in product SDSs and summarized findings are in Table 5‑46. The product containing methylene chloride, 116 Rubber Rejuvenator, was rated as combustible. Three of the alternative products (I.P. Wash, Tech Wash-IF, and California Wash) were also labeled combustible, one rated extremely flammable, and one labeled non-flammable. Based on the product reviews, there is a mix of flammability ratings for alternative products on the market, including at least one non-flammable option.

| Table 5‑46: Flash point and flammability ratings for conventional press wash products based on information in SDSs or technical data sheets | | | |
| --- | --- | --- | --- |
| Supplier | Product | Flash Point | Flammability Rating |
| Hurst Chemical Company | 116 Rubber Rejuvenator | 101 °F (38 °C) | Combustible |
| Tower | I.P. Wash | 112 °F (44 °C) | Combustible |
| Tower | Tech Wash-IF | >100 °F (38 °C) | Combustible |
| Tower | Infinity Wash | 147 °F (64 °C) | Non-flammable |
| Varn International | California Wash | >100 °F (38 °C) | Combustible |
| Varn International | Metering Roller Cleaner | 0 °F (-18 °C) | Extremely flammable |
| Note: Orange shaded rows indicate products that contain methylene chloride. | | | |

### Pricing and Customer Reviews

Pricing information was collected on publicly available websites when available. List prices for Tower products were not available online and a Tower sales associate was contacted via phone for pricing. To assist in comparing prices across various products and product sizes, the prices were normalized to price per ounce. Pricing was collected in July 2021 and summarized in Table 5‑47. Pricing for the product containing methylene chloride, 116 Rubber Rejuvenator, was higher than all reviewed alternative products at $0.62 per ounce. Alternative product pricing ranged from $0.28 per ounce (Metering Roller Cleaner) to $0.37 per ounce (Infinity Wash).

Customer review information was not available for this product category, as products are primarily sold business-to-business or through specialty third party contractors. Although customer-written reviews were not found, the sales associate at Tower mentioned customer complaints around low-VOC products on the market. Costumers describe that low VOC options tend to be more "oily" in consistency and dry much more slowly.

| Table 5‑47: Pricing and customer review information for conventional press wash products based on manufacturer and retailer web pages | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | Retail or general product  information | Price per ounce | Customer ratings (out of 5) | Number of customer reviews |
| Hurst Chemical Company | 116 Rubber Rejuvenator | <https://www.gwjcompany.com/index.php?main_page=product_info&cPath=79_415&products_id=1753> | $0.62 | None | None |
| Tower | I.P. Wash | <https://www.towerproducts.com/ipwash> | $0.37 | None | None |
| Tower | Tech Wash-IF | <https://www.towerproducts.com/techwash-if> | $0.35 | None | None |
| Tower | Infinity Wash | <https://www.towerproducts.com/infinitywashhmk-1wm> | $0.37 | None | None |
| Varn International | California Wash | <https://www.gwjcompany.com/index.php?main_page=product_info&cPath=87_940&products_id=1711> | $0.29 | None | None |
| Varn International | Metering Roller Cleaner | <https://www.gwjcompany.com/index.php?main_page=product_info&cPath=87_940&products_id=999> | $0.28 | None | None |
| Note: Orange shaded rows indicate products that contain methylene chloride. | | | | | |

### Conclusion

The market review of conventional press wash products included one product containing methylene chloride, and five products containing a variety of alternative solvents. EPA did not find barriers around pricing or fire safety that may be caused by restricting use of methylene chloride in this product category. None of the methylene chloride or alternative products reviewed at the concentrations as packaged would be compliant with the California VOC limit of 100 g/l. One of the alternative products reviewed was rated non-flammable, indicating that some market share of available alternatives are non-flammable products. Pricing for the product containing methylene chloride was higher than all reviewed alternative products. This product category is already dominated by technological and economically viable alternative products, so restricting methylene chloride in this product category would not be expected to substantially change the market.

## Dry Cleaning and Spot Removers

Spot cleaners are used to treat stains or spots on textiles. Spot cleaners are available for a wide range of textiles and formulated for use with commercial wet and dry cleaning solvents, and for residential use. This analysis focused on carpet and laundry spot cleaners for commercial and consumer use. Products are available in aerosol or liquid form, and in sizes ranging from ounces to gallons. Note that the products containing methylene chloride, trichloroethylene, perchloroethylene, and 1-bromopropane are geared toward commercial or specialty difficult to clean applications, whereas consumer general purpose laundry and carpet products do not contain them.

### Solvent Ingredients

This review included a carpet spot cleaner containing methylene chloride and perchloroethylene, one spot remover containing 1-bromopropane, and one dry cleaning spot cleaner containing trichloroethylene. Six spot cleaner products containing alternative solvents, including 2-(2 propoxyethoxy) ethanol, water, 2-butoxy-ethanol, ethoxylated isotridecyl alcohol, and others were also reviewed. Table 5‑48 shows the list of products reviewed for this analysis and their primary solvent ingredients.

| Table 5‑48: Safety data sheets and solvent ingredients with concentrations 5% or higher for reviewed spot cleaners | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | SDS | SDS date | Solvent ingredients | Concentration (%) |
| American Niagara | Pull Out 2 - Dry White Powdered Spotter | https://american-niagara.com/assets/images/SDS/SDS-PULL%20OUT%202.pdf | 31 December 2014 | Petroleum Gases | 28 - 46 |
| Methylene Chloride | 21 - 34 |
| Perchloroethylene | 16 - 26 |
| Silica | 2 - 5 |
| Pettyjohn's Solutions | Pettyjohn's Solutions® Homerun Cleaning Fluid | <https://pettyjohnsolutions.com/wp-content/uploads/2017/08/MSDS-Homerun-Cleaning-Fluid.pdf> | July 2012 | 1-Bromopropane | >96 |
| A.L. Wilson Chemical Co. | TarGo Dry | <https://www.alwilson.com/products/targo_dry/TarGo%20Dry%20MSDS.pdf> | 30 August 2018 | Ethanol 2-(2-butoxyethoxy) | 30 - 50 |
| Trichloroethylene | 15 - 25 |
| Methyl Isoamyl Ketone [5-methylhexan-2-one] | 5 - 15 |
| A.L. Wilson Chemical Co. | TarGo EF | <https://www.alwilson.com/products/targo_ef/TarGo%20EF-%20IMPROVED%20%20MSDS.pdf> | 09 August 2017 | 2-(2 Propoxyethoxy) Ethanol | 20 - 30 |
| 2-(2-Ethoxyethoxy) Ethyl Acetate | 15 - 25 |
| 2-(2 Butoxy Ethoxy) Ethyl Acetate | 15 - 25 |
| DPNB (Dipropylene glycol n-butylether) | 10 - 20 |
| Distillate Hydrotreated Light | 5 - 10 |
| Chem-Dry | Professional Strength Spot Remover | <https://mbyc.net/MSDS/pdf_1308896204.pdf> | June 2010 | Water | 60 - 100 |
| Dipropylene glycol methyl ether | 1 - 5 |
| 1-methoxy-2-propanol | 1 - 5 |
| Zep | Instant Carpet and Upholstery Spot Remover | <https://images.thdstatic.com/catalog/pdfImages/27/272c04c8-f1b7-4c71-93a4-7cd31d498fc4.pdf> | 17 September 2018 | 2-butoxyethanol | ≥5 – 10 |
| Acetone | 1 – 5% |
| Resolve | Professional Spot and Stain Carpet Cleaner | <https://images.thdstatic.com/catalog/pdfImages/ae/ae21a0d7-3b39-4395-9ba6-c8311021f09f.pdf> | 05 November 2015 | No solvents listed in the SDS | N/A |
| SC Johnson | Shout Triple-Action Laundry Stain Remover | <https://images.thdstatic.com/catalog/pdfImages/1b/1b1ddf4b-f4a3-4f43-80bc-942e85a6f297.pdf> | 10 September 2018 | Ethoxylated Isotridecyl Alcohol | 1- 5 |
| Seventh Generation | Laundry Stain Remover | <https://www.seventhgeneration.com/sites/default/files/2020-07/sdsfm000082-00-12laundrystainremoversprayen2020-06-16.pdf> | 16 June 2020 | Water | 30 - 100 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

Table 5‑49 shows the anticipated, approximate market share percentage of primary solvents used in products estimated using the chemical ranking procedure. The current market share percentage for methylene chloride, trichloroethylene, and 1-bromopropane may be skewed higher since there are many more products without these chemicals that were not included in the review. If restrictions were implemented for methylene chloride then it is anticipated that water would be the most prevalent solvent used in replacement products.

| Table 5‑49: Estimated percentage share of solvent ingredients for reviewed spot cleaners | | |
| --- | --- | --- |
| Solvent | Current market share | Projections for replacement products |
| Methylene Chloride | 5% | 0% |
| Perchloroethylene | 3% | 0% |
| 1-Bromopropane | 13% | 0% |
| Trichloroethylene | 3% | 0% |
| Water | 50% | 66% |
| Ethanol 2-(2-butoxyethoxy) | 6% | 8% |
| Other | 21% | 26% |
| Notes: The figures shown here are based on a proxy chemical ranking procedure, which draws upon factors including concentration in the product and availability and quality of product reviews. Orange shading indicates methylene chloride. Grey shading indicates another one of the first 10 TSCA work plan chemicals. Given the regulatory uncertainty while EPA considers risk management options for these chemicals, this analysis assumes any of the first 10 TSCA chemicals would not be adopted as alternative for methylene chloride while this regulatory uncertainty exists. | | |

### Volatile Organic Compounds (VOC) Content

VOC information in product SDSs were reviewed and a summary of the findings are in Table 5‑50. The EPA does not have a VOC limit in spot cleaners. However, several states have limits for aerosol spot cleaners (15-25% VOC) and non-aerosol spot cleaners (3-8% VOC). None of the product SDSs besides the methylene chloride product (Pull Out 2), included VOC information which makes it difficult to ascertain if any of these products are VOC compliant with state regulations. The two products containing trichloroethylene and 1-Bromopropane likely have high VOC content given their non-VOC exempt ingredients. Two alternative products (Chem-Dry and Seventh Generation) contain significant amounts of water and likely have low VOC content.

| Table 5‑50: VOC content for spot cleaners based on information in SDSs or technical data sheets | | |
| --- | --- | --- |
| Supplier | Product | VOC  (% weight, g/L) |
| American Niagara | Pull Out 2 - Dry White Powdered Spotter | 43.6%, 301.91936 g/L |
| Pettyjohn's Solutions | Pettyjohn's Solutions Homerun Cleaning Fluid | No information in SDS; likely high VOC content since >96% 1-BP |
| A.L. Wilson Chemical Co. | TarGo Dry | No information in SDS; likely high VOC content since 50 - 90% non-VOC exempt ingredients |
| A.L. Wilson Chemical Co. | TarGo EF | No information in SDS |
| Chem-Dry | Professional Strength Spot Remover | No information in SDS; likely low VOC content since contains 60 – 100% water |
| Zep | Instant Carpet and Upholstery Spot Remover | No information in SDS |
| Resolve | Professional Spot and Stain Carpet Cleaner | No information in SDS |
| SC Johnson | Shout Triple-Action Laundry Stain Remover | No information in SDS |
| Seventh Generation | Laundry Stain Remover | Not available; likely low VOC content since contains 30 – 100% water |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | |

### Fire Safety

Flash points and flammability ratings were reviewed in product SDSs and summarized findings are in Table 5‑51. Pull Out 2, which contains methylene chloride, was rated as extremely flammable. For products containing trichloroethylene and 1-bromopropane, Pettyjohn's Solutions Homerun Cleaning Fluid was rated non-flammable, and TarGo Dry was rated combustible. All products with alternative solvents were rated non-flammable. Based on our review, there are numerous non-flammable alternatives to products containing methylene chloride.

| Table 5‑51: Flash point and flammability ratings for spot cleaners based on information in SDSs or technical data sheets | | | |
| --- | --- | --- | --- |
| Supplier | Product | Flash Point | Flammability Rating |
| American Niagara | Pull Out 2 - Dry White Powdered Spotter | No information available | Extremely Flammable |
| Pettyjohn's Solutions | Pettyjohn's Solutions Homerun Cleaning Fluid | None | Non-flammable |
| A.L. Wilson Chemical Co. | TarGo Dry | 116 °F (46.7 °C) | Combustible |
| A.L. Wilson Chemical Co. | TarGo EF | >200 °F (93.3 °C) | Non-flammable |
| Chem-Dry | Professional Strength Spot Remover | > 212 °F (100 °C) | Non-flammable |
| Zep | Instant Carpet and Upholstery Spot Remover | No information available | Non-flammable |
| Resolve | Professional Spot and Stain Carpet Cleaner | >199.9 °F (93.3 °C) | Non-flammable |
| SC Johnson | Shout Triple-Action Laundry Stain Remover | None | Non-flammable |
| Seventh Generation | Laundry Stain Remover | No information available | Non-flammable |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | |

### Pricing and Customer Reviews

This review accessed pricing and customer review information on publicly available websites in August 2021 and summarized the findings in Table 5‑52. List prices for A.L. Wilson Chemical Co. were not available online and so a sales associate was contacted via phone for pricing. To assist in comparing prices across various products and product sizes, the prices were normalized to price per ounce. The product containing methylene chloride (Pull Out 2) was $0.95 per ounce. Pricing for products containing trichloroethylene and 1-bromopropane ranged from $0.70 (Pettyjohn's Solutions Homerun Cleaning Fluid) to $0.82 (TarGo Dry) per ounce. Pricing for alternative products ranged from $0.09 (Shout Triple-Action Laundry Stain Remover) to $0.98 (TarGo EF) per ounce. There are four alternative products with prices lower than the products containing methylene chloride.

The methylene chloride product (Pull Out 2) had an average rating of 4.5. However, the two products (Targo Dry and Pettyjohn) containing trichloroethylene and 1-bromopropane did not have customer ratings. Five of the alternative products had customer ratings available. Ratings for non-priority chemical alternative products ranged from 4.2 (Laundry Stain Remover) to 4.8 (Shout Triple-Action Laundry Stain Remover) with an average rating of 4.6. The average rating for alternative products was well above 4, indicating overall customer satisfaction with these alternative products.

| Table 5‑52: Pricing and customer review information for spot cleaners based on manufacturer and retailer web pages | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | Retail information | Price per ounce | Customer ratings (out of 5) | Number of customer reviews |
| American Niagara | Pull Out 2 - Dry White Powdered Spotter | https://www.amazon.com/ANC-White-Powdered-Aerosol-Remover/dp/B0759KGTS2 | $0.95 | 4.5 | 30 |
| Pettyjohn's Solutions | Pettyjohn's Solutions Homerun Cleaning Fluid | <https://pettyjohnsolutions.com/product/homerun-cleaning-fluid-1-gallon/> | $0.70 | None | None |
| A.L. Wilson Chemical Co. | TarGo Dry | <https://www.alwilson.com/products/targo_dry/index.html> | $0.82 | None | None |
| A.L. Wilson Chemical Co. | TarGo EF | <https://www.alwilson.com/products/targo_ef/index.html> | $0.98 | None | None |
| Chem-Dry | Professional Strength Spot Remover | <https://www.amazon.com/Chem-Dry-Professional-Strength-Spot-Remover/dp/B01B02RUU4/ref=sr_1_4?dchild=1&keywords=dry+cleaning+spot+remover&qid=1628783569&s=home-garden&sr=1-4> | $0.78 | 4.7 | 101 |
| Zep | Instant Carpet and Upholstery Spot Remover | <https://www.homedepot.com/p/ZEP-19-oz-Instant-Spot-and-Carpet-Stain-Remover-ZUSPOT19/202858110> | $0.40 | 4.6 | 82 |
| Resolve | Professional Spot and Stain Carpet Cleaner | <https://www.homedepot.com/p/Resolve-32-oz-Procare-Carpet-Spot-and-Stain-Remover-974022/202820652?MERCH=REC-_-pip_alternatives-_-100670274-_-202820652-_-N&> | $0.21 | 4.6 | 238 |
| SC Johnson | Shout Triple-Action Laundry Stain Remover | <https://www.homedepot.com/p/Shout-60-fl-Oz-Triple-Acting-Liquid-Refill-Fabric-Stain-Remover-624323/308629742#product-overview> | $0.09 | 4.8 | 241 |
| Seventh Generation | Laundry Stain Remover | <https://www.target.com/p/seventh-generation-laundry-stain-removers-free-38-clear-16-fl-oz/-/A-53346810> | $0.28 | 4.2 | 121 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

### Conclusion

The spot cleaner review included one carpet spot cleaner containing methylene chloride, 1-bromopropane, one dry cleaning spot cleaner containing trichloroethylene, and six spot cleaners containing alternative solvents. Barriers were not found around fire safety, pricing, or customer satisfaction that may be caused by restricting use of methylene chloride in this product category. Product VOC content was difficult to compare, as only one of the products had VOC information in their SDSs. However, it is likely that the water-based alternative products will have low VOC content and would be an improvement over products containing methylene chloride. All the alternative products reviewed were rated non-flammable. There are four alternative products with prices lower than the products containing methylene chloride. Customer satisfaction was high for alternative product ratings, as average ratings were over 4 out of 5 stars. Dry cleaners that convert to professional wet cleaning often switch to spot cleaners without methylene chloride, 1-bromopropane or trichloroethylene. These wet cleaners find they spend much less time and therefore less product on spot cleaning as compared to the dry cleaning process ([Onasch, Jacobs et al. 2017](#_ENREF_54)).

## Glues, Sealants, Adhesives, and Caulks: Sealants

The terms "caulk" and "sealant" are often used interchangeable since both are used for sealing joints and gaps. The key difference is that caulks are more rigid when cured than sealants. Therefore, sealants provide more elasticity and water resistance for applications with weather fluctuation and high moisture levels ([Oatey 2021](#_ENREF_43)).

Sealants are used to block passage of fluids, dusts, sound and or heat in materials. Sealants can be permanent or temporary but are not considered adhesives. Sealants are classified as chemically reactive, physically reactive, or non-reactive, and offer different properties based on their classification. They are often sold in squeeze tubes or cartridges in sizes ranging from 5 ounces to 10 ounces. This is a broad category with many products designed for specific applications; this review selected a variety of products designed for gutters, doors and windows, gaskets, or concrete and masonry.

### Solvent Ingredients

The review included one product containing methylene chloride and two products containing perchloroethylene. Four products containing alternative solvents including benzene, xylenes, PCBTF, Stoddard Solvent and petroleum distillates were also added to the review. Table 5‑53 shows the list of products reviewed for this analysis and their major solvent ingredients.

| Table 5‑53: Safety data sheets and solvent ingredients with concentrations 5% or higher for reviewed sealants | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | SDS | SDS date | Solvent ingredients | Concentration (%) |
| ITW Permatex | PX 101MA Copper Gasket Sealant | <http://www.permatex.com/wp-content/uploads/tech_docs/sds/01_USA-English/80697.pdf> | 06 February 2019 | Methylene Chloride | 10 - 30 |
| Acetone | 10 - 30 |
| Ethyl acetate | 3 - 7 |
| Solvent Naphtha | 1 - 5 |
| Amerimax Home Products, Inc. | AMERIMAX® SeamerMate® Professional Grade Permanent Gutter Seal Gray | <https://images.homedepot-static.com/catalog/pdfImages/ef/ef514f3d-2e47-4d05-8089-fbe122799797.pdf> | 01 May 2015 | Perchloroethylene | ≥50 - <75 |
| Geocel Products Group | Geocel® Instant Gutter Seal Gutter & Narrow Seam Sealant Aluminum Gray | <https://www.paintdocs.com/docs/webPDF.jsp?SITEID=GEOCEL&prodno=GC29102&doctype=SDS> | 16 January 2021 | Perchloroethylene | 50 |
| OSI | OSI GS121 Clear Synthetic Polymer Gutter Sealant | <https://images.thdstatic.com/catalog/pdfImages/ef/ef67d334-e411-47cf-80ca-552684ba1083.pdf> | 28 October 2014 | Benzene, ethenyl-, polymer with (1- methylethenyl)benzene, hydrogenated | 10 - 30 |
| Xylenes | 10 - 30 |
| Stoddard solvent, <0.1% Benzene | 10 - 30 |
| Ethylbenzene | 5 - 10 |
| DAP | Dynaflex 230 Window, Door, & Trim Sealant | <https://images.thdstatic.com/catalog/pdfImages/bf/bf8c1582-9e86-47eb-8e5f-2b6ae1984b5a.pdf> | 23 October 2018 | Petroleum distillates | 1 - 5 |
| Loctite | PL S10 Concrete Crack and Masonry Polyurethane Sealant | <https://images.thdstatic.com/catalog/pdfImages/90/90c9a532-dcfb-4cfd-8ca5-327f298a32ce.pdf> | 28 October 2014 | Petroleum distillates | 1 - 5 |
| OSI | Quad Window, Door, and Siding VOC Advanced Formula Sealant | <https://images.thdstatic.com/catalog/pdfImages/e4/e4c70688-06bd-4830-b68c-c021c0d9d7ce.pdf> | 13 October 2014 | PCBTF | 10 - 30 |
| Aliphatic hydrocarbon | 10 - 30 |
| Xylenes | 1 - 5 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

Table 5‑54 shows the anticipated, approximate market share percentage of primary solvents used in products estimated using the chemical ranking procedure. The current market share percentage for methylene chloride and perchloroethylene may be skewed higher since there are many more products without perchloroethylene and methylene chloride that were not included in the review. After potential chemical restrictions, it is anticipated that acetone and petroleum-based chemicals will be the most used solvents in sealant products.

| Table 5‑54: Estimated percentage share of solvent ingredients for reviewed sealants | | |
| --- | --- | --- |
| Solvent | Current market share | Projections for replacement products |
| Methylene Chloride | 10% | 0% |
| Perchloroethylene | 37% | 0% |
| Acetone | 10% | 19% |
| PCBTF | 10% | 19% |
| Petroleum distillates | 11% | 21% |
| Xylene | 7% | 13% |
| Ethylbenzene | 6% | 11% |
| Stoddard solvent | 6% | 11% |
| Other | 1% | 3% |
| Notes: The figures shown here are based on a proxy chemical ranking procedure, which draws upon factors including concentration in the product and availability and quality of product reviews. Orange shading indicates methylene chloride. Grey shading indicates another one of the first 10 TSCA work plan chemicals. Given the regulatory uncertainty while EPA considers risk management options for these chemicals, this analysis assumes any of the first 10 TSCA chemicals would not be adopted as alternative for methylene chloride while this regulatory uncertainty exists. | | |

### Volatile Organic Compounds (VOC) Content

This review included VOC information from product SDSs and summarized findings are in Table 5‑55. The VOC limit for sealants in most US states is 4% by weight. The products containing methylene chloride and perchloroethylene did not have VOC content information in their SDSs, likely because they are below the 4% limit. Three of the alternative products, Dynaflex 230, PL S10 Concrete Crack and Masonry Polyurethane Sealant, and Quad Window, Door, and Siding VOC Advanced Formula Sealant had VOC content lower than the 4% limit. OSI GS121 Clear Synthetic Polymer Gutter Sealant had the highest VOC at 37.2%. Restricting use of methylene chloride in sealants is unlikely to affect availability of low VOC products, as there are alternative sealant products on the market with VOC percentage below the 4% limit.

| Table 5‑55: VOC content for sealants based on information in SDSs or technical data sheets | | |
| --- | --- | --- |
| Supplier | Product | VOC  (% weight, g/L) |
| ITW Permatex | PX 101MA Copper Gasket Sealant | No information in SDS |
| Amerimax Home Products, Inc. | AMERIMAX SeamerMate Professional Grade Permanent Gutter Seal Gray | No information in SDS |
| Geocel Products Group | Geocel Instant Gutter Seal Gutter & Narrow Seam Sealant Aluminum Gray | No information in SDS |
| OSI | OSI GS121 Clear Synthetic Polymer Gutter Sealant | 37.2%, 337 g/l |
| DAP | Dynaflex 230 Window, Door, & Trim Sealant | 1.9%, 27 g/L |
| Loctite | PL S10 Concrete Crack and Masonry Polyurethane Sealant | 2.89%, 33 g/l |
| OSI | Quad Window, Door, and Siding VOC Advanced Formula Sealant | 1.49%, 194 g/l |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | |

### Fire Safety

Flash points and flammability ratings in product SDSs were reviewed and summarized findings are in Table 5‑56. Two products had flammability ratings other than non-flammable, PX 101MA Copper Gasket Sealant (methylene chloride) and OSI GS121 Clear Synthetic Polymer Gutter Sealant (alternative solvent). Quad Window, Door, and Siding VOC Advanced Formula Sealant is sold as a solid and does not have a flammability rating. All other products had a non-flammable rating. Based on the product reviews, restricting methylene chloride in this product category is unlikely to affect availability of non-flammable products on the market.

| Table 5‑56: Flash point and flammability ratings for sealants based on information in SDSs or technical data sheets | | | |
| --- | --- | --- | --- |
| Supplier | Product | Flash Point | Flammability Rating |
| ITW Permatex | PX 101MA Copper Gasket Sealant | -155 °F (-104 °C) | Extremely flammable |
| Amerimax Home Products, Inc. | AMERIMAX SeamerMate Professional Grade Permanent Gutter Seal Gray | >199.9 °F (>93.3 °C) | Non-flammable |
| Geocel Products Group | Geocel Instant Gutter Seal Gutter & Narrow Seam Sealant Aluminum Gray | No information in SDS | No information in SDS |
| OSI | OSI GS121 Clear Synthetic Polymer Gutter Sealant | 80.01 °F (26.67 °C) | Flammable |
| DAP | Dynaflex 230 Window, Door, & Trim Sealant | 212 °F (100 °C) | Non-flammable |
| Loctite | PL S10 Concrete Crack and Masonry Polyurethane Sealant | 192.2 °F (89 °C) | Non-flammable |
| OSI | Quad Window, Door, and Siding VOC Advanced Formula Sealant | Product is a solid. Burn Rate: <2.2mm/second | No information in SDS |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | |

### Pricing and Customer Reviews

The pricing and customer review information was gathered from publicly available websites in July 2021 and the summarized findings are in Table 5‑57. To assist in comparing prices across various products and product sizes, the prices were normalized to price per ounce. Products containing perchloroethylene or methylene chloride ranged from $0.80 per ounce to $1.35 per ounce. Alternative product pricing ranged from $0.49 per ounce to $0.78 per ounce. The pricing for all products containing perchloroethylene or methylene chloride were higher than the non-priority chemical alternative products.

All products considered in the review had at least 80 customer ratings. The higher number of reviews allows for a more accurate understanding of consumer opinions. The products containing perchloroethylene and methylene chloride had customer ratings ranging from 4.3 (Geocel Instant Gutter Seal Gutter & Narrow Seam Sealant Aluminum Gray) to 4.7 (PX 101MA Copper Gasket Sealant) with an average customer rating of 4.5. Ratings for the products with alternative solvents ranged from 3.9 (OSI GS121 Clear Synthetic Polymer Gutter Sealant) to 4.6 (Quad Window, Door, and Siding VOC Advanced Formula Sealant), with average customer rating of 4.2. Overall, the average rating of products containing an alternative solvent is lower than that of products containing perchloroethylene or methylene chloride. However, an average 4.2 rating indicates that customers are satisfied with their experience using alternative products. Based on the customer rating information reviewed, restricting methylene chloride in this product category is unlikely to limit effective options on the market that work well for consumers.

| Table 5‑57: Pricing and customer review information for sealants based on manufacturer and retailer web pages | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | Retail information | Price per ounce | Customer ratings (out of 5) | Number of customer reviews |
| ITW Permatex | PX 101MA Copper Gasket Sealant | https://www.amazon.com/Permatex-Gasket-Hi-Temp-Adhesive-Sealant/dp/B07KKN1NMT | $1.22 | 4.7 | 710 |
| Amerimax Home Products, Inc. | AMERIMAX SeamerMate Professional Grade Permanent Gutter Seal Gray | <https://www.homedepot.com/p/Amerimax-Home-Products-10-oz-Gutter-Sealant-85148/100011940> | $0.80 | 4.4 | 127 |
| Geocel Products Group | Geocel Instant Gutter Seal Gutter & Narrow Seam Sealant Aluminum Gray | <https://www.amazon.com/Geocel-Corp-29102-Instant-Gutter/dp/B0007PNOBA> | $1.35 | 4.3 | 80 |
| OSI | OSI GS121 Clear Synthetic Polymer Gutter Sealant | <https://www.homedepot.com/p/OSI-GS121-10-fl-oz-Clear-Gutter-Sealant-1943973/303223987> | $0.70 | 3.9 | 123 |
| DAP | Dynaflex 230 Window, Door, & Trim Sealant | <https://www.homedepot.com/p/DAP-Dynaflex-230-10-1-oz-White-Premium-Elastomeric-Exterior-Interior-Window-Door-and-Trim-Sealant-18275/100035980> | $0.49 | 4.2 | 598 |
| Loctite | PL S10 Concrete Crack and Masonry Polyurethane Sealant | <https://www.homedepot.com/p/Loctite-PL-S10-10-fl-oz-Concrete-Crack-and-Masonry-Polyurethane-Sealant-1618522/203156788> | $0.78 | 4.2 | 354 |
| OSI | Quad Window, Door, and Siding VOC Advanced Formula Sealant | <https://www.homedepot.com/p/OSI-QUAD-Advanced-Formula-10-fl-oz-Brown-253-Exterior-Window-Door-and-Siding-Sealant-2012156/206156408> | $0.63 | 4.6 | 788 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

### Conclusion

This review of sealants selected a sampling of products designed for a variety of applications and included a product containing methylene chloride, two products containing perchloroethylene, and four products containing a variety of non-priority chemical alternative solvents. This analysis did not find barriers around fire safety, pricing, or customer satisfaction that may be caused by restricting use of methylene chloride in this product category. VOCs were more difficult to compare, as none of the products containing methylene chloride had VOC information in their SDSs. However, most of the alternative products had VOC content lower than the 4% limit, showing that there are alternative low VOC options on the market. Most of the alternative products reviewed were rated non-flammable. The pricing for all products containing perchloroethylene or methylene chloride were higher than the alternative products.

Average customer ratings of alternative products were slightly lower than that of products containing tetrachloroethylene or methylene chloride. Customer satisfaction was still high for alternative product ratings, as average ratings were over 4 out of 5 stars. Therefore, technological and economically feasible alternative products are present in the marketplace.

## Glues, Sealants, Adhesives, and Caulks: Adhesives

An adhesive is a formulated product that binds two objects together and can be applied to one or both surfaces of the two initially separate objects. Adhesives are often referred to as "glue," "paste," or "cement." There are many methods for curing adhesives. These include evaporative drying for solvent-based adhesives, cooling for hot melt adhesives, contact, and light pressure for pressure sensitive adhesives. Factors affecting choice of adhesive product include drying time, cure time, bond strength, substrate compatibility, application temperature, and interior/exterior use.

The product category is vast and diverse; there are many adhesives on the market formulated for different purposes, substrates, application methods, and users. The *Chemical Economics Handbook* divides adhesives into five categories -- water emulsions, hot-melts, solvent-based, reactive, and natural polymers ([IHS Markit 2019](#_ENREF_29)). It is beyond the scope of this analysis to investigate products for each adhesive application. Instead, the analysis includes two general purpose adhesives (high strength mist spray adhesive and high strength non-spray adhesive) and one specific purpose adhesive (for acrylic substrate). The results for these types of adhesives may or may not be representative for other adhesive applications.

### Solvent Ingredients

The review included one product containing methylene chloride, and one product containing both methylene chloride and trichloroethylene. Five products containing alternative solvents, including perchloroethylene, methyl acetate, toluene, acetone, and others were also reviewed. One alternative product (3M Scotch Weld) has a trace amount of methylene chloride of less than 0.01%. Table 5‑58 shows the list of products reviewed for this analysis and their primary solvent ingredients.

| Table 5‑58: Safety data sheets and solvent ingredients with concentrations 5% or higher for reviewed adhesives | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Supplier | Product | Appli- cation | SDS | SDS date | Solvent ingredients | Concen- tration (%) |
| 3M | 3M™ Hi-Strength Non-Flammable 98NF Bulk Adhesive | High strength spray | <https://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn_zu8l00xM82SNY_Bnv70k17zHvu9lxtD7SSSSSS--> | 5 August 2019 | Methylene Chloride | 60 - 85 |
| IPS | Weld On #3 Acrylic Plastic Cement | Acrylic | <https://www.acplasticsinc.com/media/Weld-On%203%20SDS.pdf> | 6 May 2015 | Methylene Chloride | 75 - 90 |
| Trichloroethylene | 5 - 15 |
| E6000 | E6000 MV clear industrial strength adhesive | High strength non-spray | <https://images.thdstatic.com/catalog/pdfImages/c3/c362ff98-8080-4009-984e-3cf4c0cde7db.pdf> | 6 May 2020 | Perchloroethylene | ≥50 - ≤72 |
| 3M | Scotch-Weld Low Odor Acrylic Adhesive DP8810N | Acrylic | <https://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn_zu8l00xm8txoxmZlv70k17zHvu9lxtD7SSSSSS--> | 11 November 2019 | Dibenzoate Propanol | 80 |
| Gorilla | Heavy Duty Spray Adhesive | High strength spray | <https://gorillaglue.com.au/wp-content/uploads/Gorilla-Spray-Adhesive-1.pdf> | 24 February 2019 | Methyl acetate | 10 - 30 |
| Acetone | 10 - 30 |
| Cyclohexane | 10 - 30 |
| Homax | All Purpose Adhesive Industrial Strength Welder | High strength non-spray | <https://bigcatrescue.org/wp-content/uploads/2014/04/Household-Welder.pdf> | 21 March 2006 | Toluene | 30 - 60 |
| Henkel | Loctite Professional Performance Spray Adhesive | High strength spray | <https://dm.henkel-dam.com/is/content/henkel/sds-us-loctite-spray-adhesive-professional-performance> | 7 November 2018 | Acetone | 30 - 60 |
| Methyl acetate | 5 - 10 |
| Naphtha, petroleum, hydrotreated light | 5 - 10 |
| Parachlorobenzotrifluoride | 5 - 10 |
| n-Heptane | 5 - 10 |
| Methylcyclohexane | 5 - 10 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | | |

Table 5‑59 shows the anticipated, approximate market share percentage of primary solvents used in products estimated using the chemical ranking procedure. If restrictions were implemented for methylene chloride, then it is anticipated that acetone would be the most prevalent solvent used in replacement products. In addition, a process change (*e.g.*, adoption of a hot-melt technology) may be an option in some cases. There are several solvents used in alternative products that contain GreenScreen Benchmark 1 chemicals such as toluene and Parachlorobenzotrifluoride.[[13]](#footnote-15) These Benchmark 1 solvents are potential regrettable substitutions for methylene chloride. There are numerous commercially available alternative products for adhesive products without Benchmark 1 solvents.

| Table 5‑59: Estimated percentage share of solvent ingredients for reviewed adhesive applications only | | |
| --- | --- | --- |
| Solvent | Current market share | Projections for replacement products |
| Methylene Chloride | 32% | 0% |
| Perchloroethylene | 13% | 0% |
| Trichloroethylene | 2% | 0% |
| Acetone | 15% | 28% |
| Dibenzoate propanol | 12% | 24% |
| Methyl acetate | 8% | 15% |
| Toluene | 7% | 13% |
| Cyclohexane | 4% | 8% |
| Other | 6% | 12% |
| Notes: The figures shown here are based on a proxy chemical ranking procedure, which draws upon factors including concentration in the product and availability and quality of product reviews. Orange shading indicates methylene chloride. Grey shading indicates another one of the first 10 TSCA work plan chemicals. Given the regulatory uncertainty while EPA considers risk management options for these chemicals, this analysis assumes any of the first 10 TSCA chemicals would not be adopted as alternative for methylene chloride while this regulatory uncertainty exists. | | |

### Volatile Organic Compounds (VOC) Content

VOC information was reviewed in product SDSs and summarized findings are in Table 5‑60. The VOC limit for mist spray adhesives is 30% in California and 65% for many other states. The VOC limit for general purpose adhesives is 10% for the EPA and many states. A VOC limit for acrylic specific adhesives was not identifiable (*e.g.*, Weld On #3 Acrylic Plastic Cement).

Two of the products containing methylene chloride and trichloroethylene had VOC content data available: 3M Hi-Strength Non-Flammable 98NF Bulk Adhesive (0 g/L) and Weld On #3 Acrylic Plastic Cement (> 250 g/L). The 3M Hi-Strength Non-Flammable 98NF Bulk Adhesive product would meet the VOC limit for general purpose adhesives. Two alternative products had VOC content information: Loctite Professional Performance Spray Adhesive (38.8%), and 3M Scotch-Weld Low Odor Acrylic Adhesive DP8810N (59.4 g/L). The Loctite Professional Performance Spray Adhesive would meet the VOC limit for spray adhesives in all states except California. VOC content information was not available for the other two alternative products (Gorilla and Homax).

| Table 5‑60: VOC content for adhesives based on information in SDSs or technical data sheets | | |
| --- | --- | --- |
| Supplier | Product | VOC  (% weight, g/L) |
| 3M | 3M Hi-Strength Non-Flammable 98NF Bulk Adhesive | VOC Less H2O & Exempt Solvents: 0 g/L |
| IPS | Weld On #3 Acrylic Plastic Cement | 250 g/L |
| E6000 | E6000 MV clear industrial strength adhesive | No information in SDS |
| 3M | Scotch-Weld Low Odor Acrylic Adhesive DP8810N | 59.4 g/L |
| Gorilla | Heavy Duty Spray Adhesive | No information in SDS |
| Homax | All Purpose Adhesive Industrial Strength Welder | No information in SDS |
| Henkel | Loctite Professional Performance Spray Adhesive | 38.8% |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | |

### Fire Safety

Flash points and flammability ratings in product SDSs were reviewed and summarized findings are in Table 5‑61. Both products containing methylene chloride were rated non-flammable. The alternative products were rated non-flammable, flammable, or extremely flammable. Restricting methylene chloride in this product categories may limit non-flammable options currently on the market. However, this product review was limited, and other non-flammable adhesive options are likely to be available for other adhesive types.

| Table 5‑61: Flash point and flammability ratings for adhesives based on information in SDSs or technical data sheets | | | |
| --- | --- | --- | --- |
| Supplier | Product | Flash Point | Flammability Rating |
| 3M | 3M Hi-Strength Non-Flammable 98NF Bulk Adhesive | No flash point | Non-flammable |
| IPS | Weld On #3 Acrylic Plastic Cement | None | Non-flammable |
| E6000 | E6000 MV clear industrial strength adhesive | >230 °F (>110 °C) | Non-flammable |
| 3M | Scotch-Weld Low Odor Acrylic Adhesive DP8810N | > 200 °F | Non-flammable |
| Gorilla | Heavy Duty Spray Adhesive | -155 °F (-104 °C) | Extremely flammable |
| Homax | All Purpose Adhesive Industrial Strength Welder | 45 °F (7 °C) | Flammable |
| Henkel | Loctite Professional Performance Spray Adhesive | -155 °F (-104 °C) | Extremely flammable |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | |

### Pricing and Customer Reviews

Pricing and customer review information was assessed on publicly available websites in August 2021 and a summary of the findings is in Table 5‑62. To assist in comparing prices across various products and product sizes, the prices were normalized to price per ounce. Reviewed products ranged widely in volume from two ounces (E6000 MV clear industrial strength adhesive and All Purpose Adhesive Industrial Strength Welder) to 54 gallons (3M Hi-Strength Non-Flammable 98NF Bulk Adhesive).

Pricing for products containing methylene chloride, perchloroethylene and trichloroethylene ranged from $0.43 (3M Hi-Strength Non-Flammable 98NF Bulk Adhesive; note that this product volume was 54 gallons) to $4.24 per ounce. Pricing for alternative products ranged from $0.68 (Heavy Duty Spray Adhesive) to $4.55 (All Purpose Adhesive Industrial Strength Welder) per ounce. The price range for alternative products had considerable overlap with products containing perchloroethylene, methylene chloride and trichloroethylene.

Two of the products containing methylene chloride, perchloroethylene and trichloroethylene had reviews of 4.7 (E6000 MV clear industrial strength adhesive) and 4.6 (Weld On #3 Acrylic Plastic Cement) with an average rating around 4.7. Ratings for alternative products ranged from 3.5 to 5.0 with an average rating of 4.4. The average customer ratings for alternative products were slightly lower than those of products with methylene chloride. However, the average rating of alternative products was 4.4, indicating overall customer satisfaction with these products.

| Table 5‑62: Pricing and customer review information for adhesives based on manufacturer and retailer web pages | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | Retail information | Price per ounce | Customer ratings (out of 5) | Number of customer reviews |
| 3M | 3M Hi-Strength Non-Flammable 98NF Bulk Spray Adhesive | <https://www.amazon.com/3M-Scotch-Weld-98NF-Spray-Adhesive/dp/B0046VQQBG> | $0.43 | None | None |
| IPS | Weld On #3 Acrylic Plastic Cement | <https://www.amazon.com/Weld-Acrylic-Plastic-Cement-Applicator/dp/B0149IG548> | $4.22 | 4.6 | 826 |
| E6000 | E6000 MV clear industrial strength adhesive | https://www.homedepot.com/p/E6000-2-fl-oz-Clear-Adhesive-237032/203279322 | $4.24 | 4.7 | 4,523 |
| 3M | Scotch-Weld Low Odor Acrylic Adhesive DP8810N | <https://www.amazon.com/3M-Scotch-Weld-Acrylic-Adhesive-DP8810NS/dp/B00IOQ6W0E> | $1.13 | 5.0 | 2 |
| Gorilla | Heavy Duty Spray Adhesive | <https://www.amazon.com/dp/B0752XM8VN> | $0.68 | 4.5 | 5,390 |
| Homax | All Purpose Adhesive Industrial Strength Welder | <https://www.amazon.com/Purpose-Adhesive-Industrial-Strength-Welder/dp/B074M7BW62> | $4.55 | 4.7 | 170 |
| Henkel | Loctite Professional Performance Spray Adhesive | <https://www.homedepot.com/p/Loctite-Professional-Performance-13-5-oz-Spray-Adhesive-1629134/205506865> | $0.73 | 3.5 | 10 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

### Conclusion

The market review of adhesives was limited to three representative types of adhesives. The review included one product containing methylene chloride, one product containing both trichloroethylene and methylene chloride, and a number of products containing alternative solvents. At least one alternative product would meet the VOC limit for spray adhesives in all states except California. Restricting methylene chloride in the adhesives reviewed here may potentially limit non-flammable options currently on the market. However, the product review was limited, and other non-flammable adhesive options may be available. In addition, the review did not include non-solvent-based adhesive technologies which may be adopted through a process change. The price range for alternative products had considerable overlap with products containing methylene chloride. Average customer ratings of alternative products were slightly lower than that of products containing a methylene chloride. Customer satisfaction was still high for alternative product ratings, as average ratings were 4.4 out of 5 stars.

## Lubricants and Greases: High Temperature Anti-Seize Copper

Lubricants are used on metals to reduce friction, clean, and/ or protect against corrosion and rust. There are many types of lubricants on the market ranging for specialized uses, such as anti-seize and wire lubricants, to more general use lubricants, such as multi-purpose lubricants and penetrants. Products are sold in liquid, liquid spray, and aerosol form. Many lubricants are available for commercial and consumer use; however, these are likely available in larger quantities for industrial use as well. The review focuses on high temperature copper lubricants and penetrants in liquid spray or aerosol form in volumes from 11 to 14 ounces.

### Solvent Ingredients

The review included a product with methylene chloride. Five products were also reviewed containing alternative solvents, including heptane, copper, propane, petroleum distillates, and others. Table 5‑63 shows the list of products reviewed for this analysis and their primary solvent ingredients.

| Table 5‑63: Safety data sheets and solvent ingredients with concentrations 5% or higher for  reviewed multi-purpose lubricants | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | SDS | SDS date | Solvent ingredients | Concentration (%) |
| Delta Foremost Chemical Corporation | High Temp Anti-Seize Copper | https://deltaforemost.com/search/FM%20607-ES%20Hi-Temp%20Anti-Seize%20Coppper%20Base%20Aerosol%20-%20SDS.pdf | 25 August 2019 | Methylene Chloride | Proprietary |
| CRC | Copper Anti-Seize Aerosol | https://crcindustries.com.au/products/ds/sds-3195.pdf | 18 June 2018 | Distillates (petroleum), hydrotreated heavy naphthenic | 30 - 60 |
| Petroleum Gases Liquified | 30 - 60 |
| Solvent Naphtha (petroleum), Light Aliphatic | 10 - 30 |
| Copper | 5 - 10 |
| Permatex | Copper Anti-Seize Lubricant | https://www.permatex.com/wp-content/uploads/sds/09128.pdf | 15 January 2021 | Distillates (petroleum), hydrotreated heavy paraffinic | 30 - 60 |
| Magnesium Silicate | 10 - 30 |
| Limestone | 10 - 30 |
| Gorilla – H.B. Fuller | High Temperature Anti-Seize Lubricant | https://www1.mscdirect.com/MSDS/MSDS00090/13786918-20210523.PDF | 21 August 2020 | Copper | 30 - 50 |
| Graphite | 20 - 30 |
| Jet-Lube | High Temperature Anti-Seize Lubricant – SS 30 | https://www1.mscdirect.com/MSDS/MSDS00005/00263228-20201120.PDF | 13 July 20212 | Hydrocarbons | 60 - 70 |
| Copper | 25 – 30 |
| Henkel LOCTITE | LB 8007 - C5-A Copper Based Anti-Seize Lubricant | https://cdn11.bigcommerce.com/s-jifykode7m/product\_images/uploaded\_images/msds/SGP18967.pdf | 22 January 2015 | n-Heptane | 10 - 30 |
| Acetone | 10 – 30 |
| Propane | 10 – 30 |
| Copper | 10 – 30 |
| Graphite | 10 – 30 |
| Distillates (petroleum), hydrotreated heavy naphthenic | 5 – 10 |
| Distillates (petroleum), hydrotreated light naphthenic | 5 - 10 |
| Note: Orange shaded rows indicate products that contain methylene chloride. | | | | | |

Table 5‑64 shows the anticipated, approximate market share percentage of primary solvents used in products estimated using the chemical ranking procedure. Petroleum distillates is currently the most used solvent in lubricants. If restrictions were implemented for methylene chloride, then it is anticipated that petroleum distillates would be the most prevalent solvent used in replacement products.

| Table 5‑64: Estimated percentage share of solvent ingredients for reviewed multi-purpose lubricants | | |
| --- | --- | --- |
| Solvent | Current market share | Projections for replacement products |
| Methylene Chloride | Unknown | 0% |
| Petroleum distillates | 30 - 40% | 40% |
| Magnesium Silicate | 5 - 10% | 10% |
| Hydrocarbons | 10 - 20% | 20% |
| Heptane | 1 - 5% | 5% |
| Acetone | 1 - 5% | 5% |
| Propane | 1 - 5% | 5% |
| Graphite | 1 - 5% | 5% |
| Other | 5 - 10% | 10% |
| Total | 100% | 100% |
| Notes: The figures shown here are based on a proxy chemical ranking procedure, which draws upon factors including concentration in the product and availability and quality of product reviews. Orange shading indicates methylene chloride. | | |

### Volatile Organic Compounds (VOC) Content

EPA reviewed VOC information in product SDSs and summarized findings in Table 5‑65. EPA identified VOC limits for several lubricant types in a number of states, including multipurpose (25 - 50%) and silicone multipurpose lubricants (60%) excluding dry lubricants and penetrants (25 - 50%). The product containing methylene chloride did not have VOC data in the SDS. Only three of the alternative products had VOC content information. LB 8007 - C5-A Copper Based Anti-Seize Lubricant had VOC content at 35.9% and both High Temperature Anti-Seize Lubricant – SS 30 and Copper Anti-Seize Lubricant had lower VOC content at 0%. VOC content cannot be compared between products containing methylene chloride with alternative products due to lack of VOC data. Two alternative products had VOC content at 0%, indicating that there are low VOC alternatives available.

| Table 5‑65: VOC content for multi-purpose lubricants based on information in SDSs or technical data sheets | | |
| --- | --- | --- |
| Supplier | Product | VOC  (% weight, g/L) |
| Delta Foremost Chemical Corporation | High Temp Anti-Seize Copper | No information in SDS |
| CRC | Copper Anti-Seize Aerosol | No information in SDS |
| Permatex | Copper Anti-Seize Lubricant | 0% |
| Gorilla – H.B. Fuller | High Temperature Anti-Seize Lubricant | No information in SDS |
| Jet-Lube | High Temperature Anti-Seize Lubricant – SS 30 | 0% |
| Henkel LOCTITE | LB 8007 - C5-A Copper Based Anti-Seize Lubricant | 35.9% |

### Fire Safety

Flash points and flammability ratings in product SDSs were reviewed and summarized findings are in Table 5‑66. The six products reviewed had mixed flammability ratings. The product containing methylene chloride, High Temp Anti-Seize Copper, was rated as extremely flammable. One of the alternative products was also rated as extremely flammable (Copper Anti-Seize Aerosol) and three were rated flammable. One of the alternatives (High Temperature Anti-Seize Lubricant) was not classified as a flammability hazard. It is unclear how restriction of methylene chloride in this product category will affect fire safety. The review was limited and may not have captured the alternative products with the lowest flammability ratings available.

| Table 5‑66: Flash point and flammability ratings for multi-purpose lubricants based on information in SDSs | | | |
| --- | --- | --- | --- |
| Supplier | Product | Flash Point | Flammability Rating |
| Delta Foremost Chemical Corporation | High Temp Anti-Seize Copper | < 73 °F (< 22.8 °C) | Extremely flammable, aerosol |
| CRC | Copper Anti-Seize Aerosol | < 32 °F (< 0°C) | Extremely flammable, aerosol |
| Permatex | Copper Anti-Seize Lubricant | 421 °F (216 °C) | Flammable, aerosol |
| Gorilla – H.B. Fuller | High Temperature Anti-Seize Lubricant | No information in SDS | Not classified as a flammability hazard |
| Jet-Lube | High Temperature Anti-Seize Lubricant – SS 30 | > 590 °F (> 310 °C) | Flammable, aerosol |
| Henkel LOCTITE | LB 8007 - C5-A Copper Based Anti-Seize Lubricant | < -17 °F (< 1.4 °C) | Flammable, aerosol |

### Pricing and Customer Reviews

Pricing and customer review information was assessed on publicly available websites in May 2022 and summary of the findings are in Table 5‑67. To assist in comparing the prices across various products and product sizes, the prices were normalized to price per ounce. The methylene chloride product had a price of $2.35 per ounce. Pricing for alternative products ranged from $1.67 (Copper Anti-Seize Lubricant) to $7.82 (High Temperature Anti-Seize Lubricant - SS 30) per ounce. Three alternative products had lower prices than the product containing methylene chloride.

The product containing methylene chloride did not have any online customer reviews. Customer ratings for alternative products ranged from 4.4 (Copper Anti-Seize Aerosol) to 4.8 (Copper Anti-Seize Lubricant and High Temperature Anti-Seize Lubricant – SS 30). Although there was no customer rating for the methylene chloride product to compare to, the alternative products ratings suggest overall high customer satisfaction.

| Table 5‑67: Pricing and customer review information for multi-purpose lubricants based on  manufacturer and retailer web pages | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | Retail information | Price per ounce | Customer ratings (out of 5) | Number of customer reviews |
| Delta Foremost Chemical Corporation | High Temp Anti-Seize Copper | No online pricing found; contacted company for information | $2.35 | None | None |
| CRC | Copper Anti-Seize Aerosol | https://www.amazon.com/CRC-14095-Copper-Anti-Seize-Weight/dp/B0013J403A/ref=sr\_1\_2?crid=2FAOTU1YZ1R90&keywords=aerosol+anti+seize+crc&qid=1661262843&sprefix=aerosol+anti+seize+crc+%2Caps%2C82&sr=8-2 | $3.43 | 4.4 | 55 |
| Permatex | Copper Anti-Seize Lubricant | https://www.amazon.com/dp/B000HBM8HU | $1.67 | 4.8 | 2,870 |
| Gorilla – H.B. Fuller | High Temperature Anti-Seize Lubricant | https://www.mscdirect.com/product/details/13786918 | $1.96 | None | None |
| Jet-Lube | High Temperature Anti-Seize Lubricant – SS 30 | https://www.mscdirect.com/product/details/00263210 | $7.82 | 4.8 | 133 |
| Henkel LOCTITE | LB 8007 - C5-A Copper Based Anti-Seize Lubricant | https://skygeek.com/henkel-51003-loctite-c5-a-copper-anti-seize-aerosol-12-oz.html?msclkid=b2c718fc6087127f29437a39dc76debb | $2.29 | None | None |

### Conclusion

The review focused only on high temperature copper anti-seize lubricants in liquid spray or aerosol form and included one product containing methylene chloride, and five products containing alternative solvents. There were no barriers found around pricing and customer satisfaction. VOC was unable to be compared due to lack of VOC information in SDSs for products containing methylene chloride. For fire safety, the review was limited and may not have captured the alternative products with the lowest flammability ratings available. Three alternative products had lower prices than any of the products containing methylene chloride. Average customer satisfaction ratings were high for products using alternative solvents.

## Lubricants and Greases: Dry Moly Aerosols

Lubricants are used on metals to reduce friction, clean, and/ or protect against corrosion and rust. There are many types of lubricants on the market ranging for specialized uses, such as anti-seize and wire lubricants, to more general use lubricants, such as multi-purpose lubricants and penetrants. Products are sold in liquid, liquid spray, and aerosol form. Many lubricants are available for commercial and consumer use; however, these are likely available in larger quantities for industrial use as well. The review focuses on dry moly lubricants and penetrants in aerosol form in volumes from 11 to 14 ounces.

### Solvent Ingredients

The review included products with methylene chloride. Four products were also reviewed containing alternative solvents, including acetone, butane, propane, naptha (petroleum), and others. Table 5‑63 shows the list of products reviewed for this analysis and their primary solvent ingredients.

| Table 5‑68: Safety data sheets and solvent ingredients with concentrations 5% or higher for  reviewed multi-purpose lubricants | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | SDS | SDS date | Solvent ingredients | Concentration (%) |
| Delta Foremost Chemical Corporation | ES Dry Moly Aerosol | https://deltaforemost.com/search/FM%20606-ES%20Dry%20Moly%20Aerosol%20-%20SDS.pdf | 12 September 2021 | Methylene Chloride | Proprietary |
| Mid American Chemical Corporation | Patrol Dry-Moly Lubricant | https://www.marc1.com/uploads/1/1/5/2/115201113/sds\_marc\_167\_03\_16\_2022.pdf | 16 March 2022 | Methylene Chloride | 50 - < 100 |
| Butane | 10 - < 20 |
| Propane | 5 - < 10 |
| Methyl Benzene | 5 - < 10 |
| Momar Inc | Moly DSD Aerosol | https://momarhaystack.com/data/productsandequipment/molydsdaerosol//molydsdaerosol\_sds.pdf | 23 May 2019 | Methylene Chloride | 60 - 100 |
| Propane/n-Butane | 10 - 30 |
| QuestSpecialty Corporation | MoliGuard | https://questspecialty.com/sds/5440-5441-5449\_SDS\_QS.pdf | 23 May 2019 | Methylene Chloride | 60 - 100 |
| Propane/n-Butane | 10 - 30 |
| CRC | Dry Moly Lube | http://images.salsify.com/image/upload/s--T6KmRnNN--/fzzomugfln8qqjm3h0mm.pdf | 23 November 2019 | Acetone | 30 - < 40 |
| Isopropyl Alcohol | 20 - < 30 |
| n-Butane | 20 - < 30 |
| Naptha (petroleum), hydrotreated light | 5 - < 10 |
| Propane | 5 - < 10 |
| ProChem | Moly-Lub | https://procheminc.com/wp-content/uploads/2015/08/MOLY-LUBE-1714-SDS.pdf | 5 May 2021 | Butane | 20 - < 50 |
| 2-Propanone | 20 - < 50 |
| Propane | 5 - < 10 |
| Solvent Naptha (petroleum), light | 5 - < 10 |
| Naptha (petroleum), heavy alkylate | 5 - < 10 |
| Share Corporation | Moly Lube | http://sharecorp.com/sites/default/files/822701\_120221%20Share%20Corporation%20Moly%20Lube\_SDS.pdf |  | Acetone | 25 - 35 |
| Propane | 15 - 25 |
| Isopropanol | 10 - 20 |
| Methyl Acetate | 10 - 20 |
| Butane | 5 - < 10 |
| Aervoe | Crown 6080 Dry Moly Lubricant | https://aervoe.com/\_files/msds/Dry%20Moly%20Lubricant%206080%20-%20US.pdf | 12 April 2018 | Acetone | 40 - 70 |
| Hydrocarbon Propellant | 15 - 40 |
| Note: Orange shaded rows indicate products that contain methylene chloride. | | | | | |

Table 5‑64 shows the anticipated, approximate market share percentage of primary solvents used in products estimated using the chemical ranking procedure. If restrictions were implemented for methylene chloride, then it is anticipated that butane would be the most prevalent solvent used in replacement products.

| Table 5‑69: Estimated percentage share of solvent ingredients for reviewed multi-purpose lubricants | | |
| --- | --- | --- |
| Solvent | Current market share | Projections for replacement products |
| Methylene Chloride | 37% | 0% |
| Butane | 30% | 47% |
| Acetone | 23% | 36% |
| Propane | 11% | 17% |
| Total | 100% | 100% |
| Notes: The figures shown here are based on a proxy chemical ranking procedure, which draws upon factors including concentration in the product and availability and quality of product reviews. Orange shading indicates methylene chloride. Given the regulatory uncertainty while EPA considers risk management options for these chemicals, this analysis assumes any of the first 10 TSCA chemicals would not be adopted as alternative for methylene chloride while this regulatory uncertainty exists. | | |

### Volatile Organic Compounds (VOC) Content

EPA reviewed VOC information in product SDSs and summarized findings in Table 5‑65. EPA identified VOC limits for several lubricant types in a number of states, including multipurpose (25 - 50%) and silicone multipurpose lubricants (60%) excluding dry lubricants and penetrants (25 - 50%). Two products containing methylene chloride did not have VOC data in their SDSs. Only two of the alternative products had VOC content information. Moly DSD Aerosol and Moliguard had VOC content at 24%. Two alternative products had VOC information; Dry Moly Lube had 61.8% VOC content and Moly Lube had a higher VOC content at 95%. The review was limited and may not have captured the alternative products with the lowest VOC content available.

| Table 5‑70: VOC content for multi-purpose lubricants based on information in SDSs or technical data sheets | | |
| --- | --- | --- |
| Supplier | Product | VOC  (% weight, g/L) |
| Delta Foremost Chemical Corporation | ES Dry Moly Aerosol | No information in SDS |
| Mid American Chemical Corporation | Patrol Dry-Moly Lubricant | No information in SDS |
| Momar Inc | Moly DSD Aerosol | 24% |
| QuestSpecialty Corporation | MoliGuard | 24% |
| CRC | Dry Moly Lube | 61.8% |
| ProChem | Moly-Lub | No information in SDS |
| Share Corporation | Moly Lube | 95% |
| Aervoe | Crown 6080 Dry Moly Lubricant | No information in SDS |
| Note: Orange shaded rows indicate products that contain methylene chloride. | | |

### Fire Safety

Flash points and flammability ratings in product SDSs were reviewed and summarized findings are in Table 5‑66. The nine products reviewed all were flammable or extremely flammable. Three products containing methylene chloride, ES Dry Moly Aerosol, Moly DSD Aerosol, and MoliGuard had ratings of extremely flammable. All of the alternative products are aerosols and were rated flammable. It is unclear how restriction of methylene chloride in this product category will affect fire safety. The review was limited and may not have captured the alternative products with the lowest flammability ratings available.

| Table 5‑71: Flash point and flammability ratings for multi-purpose lubricants based on information in SDSs | | | |
| --- | --- | --- | --- |
| Supplier | Product | Flash Point | Flammability Rating |
| Delta Foremost Chemical Corporation | ES Dry Moly Aerosol | <73 °F (< 23 °C) | Extremely flammable, aerosol |
| Mid American Chemical Corporation | Patrol Dry-Moly Lubricant | 219.9 °F (104.4 °C) | Flammable, aerosol |
| Momar Inc | Moly DSD Aerosol | No information in SDS | Extremely flammable, aerosol |
| QuestSpecialty Corporation | MoliGuard | No information in SDS | Extremely flammable, aerosol |
| CRC | Dry Moly Lube | -20.2 °F (-29 °C) | Flammable, aerosol |
| ProChem | Moly-Lub | -155.9 °F (-104.4 °C) | Flammable, aerosol |
| Share Corporation | Moly Lube | <0 °F (< -17.7 °C) | Flammable, aerosol |
| Aervoe | Crown 6080 Dry Moly Lubricant | <0 °F (< -17.7 °C) | Flammable, aerosol |
| Note: Orange shaded rows indicate products that contain methylene chloride. | | | |

### Pricing and Customer Reviews

Pricing and customer review information was assessed on publicly available websites in June 2022 and summary of the findings are in Table 5‑67. To assist in comparing the prices across various products and product sizes, the prices were normalized to price per ounce. Pricing for products containing methylene chloride ranged from $1.14 (MoliGuard) to $1.53 per ounce (ES Dry Moly Aerosol). Pricing for alternative products ranged from $1.11 (Dry Moly Lube) to $1.12 (Crown 6080 Dry Moly Lubricant) per ounce. The alternative products had lower prices than any of the products containing methylene chloride. Only one product in the review had customer reviews (Dry Moly Lube) with a rating of 4.6 with 924 customer reviews. There was not enough information available to compare customer satisfaction with methylene chloride containing products.

| Table 5‑72: Pricing and customer review information for multi-purpose lubricants based on  manufacturer and retailer web pages | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | Retail information | Price per ounce | Customer ratings (out of 5) | Number of customer reviews |
| Delta Foremost Chemical Corporation | ES Dry Moly Aerosol | No online pricing or reviews found; contacted company for information | $1.53 | None | None |
| Mid American Chemical Corporation | Patrol Dry-Moly Lubricant | No online pricing or reviews found | None | None | None |
| Momar Inc | Moly DSD Aerosol | No online pricing or reviews found | None | None | None |
| QuestSpecialty Corporation | MoliGuard | https://www.aerosolstore.com/questspecialty-moli-guard-dry-lubricant-spray.html | $1.14 | None | None |
| CRC | Dry Moly Lube | https://www.amazon.com/CRC-03084-Lubricant-Aerosol-Spray/dp/B0013J62P4?ref\_=ast\_sto\_dp | $1.11 | 4.6 | 924 |
| ProChem | Moly-Lub | No online pricing or reviews found | None | None | None |
| Share Corporation | Moly Lube | No online pricing or reviews found | None | None | None |
| Aervoe | Crown 6080 Dry Moly Lubricant | https://www.amazon.com/Crown-205-6080-Dry-Moly-Lube/dp/B009K9GLTQ/ref=sr\_1\_222?keywords=Aervoe&qid=1661184364&sr=8-222 | $1.12 | None | None |
| Note: Orange shaded rows indicate products that contain methylene chloride. | | | | | |

### Conclusion

The review focused only on dry moly lubricants and penetrants in aerosol form and included four products containing methylene chloride, and four products containing alternative solvents. There were no barriers found around pricing and not enough information to compare customer satisfaction. The alternative products (Dry Moly Lube and Crown 6080 Dry Moly Lubricant) had lower prices than any of the products containing methylene chloride. VOC was lower for methylene chloride containing products, but the review was limited and other alternatives might have lower VOC content. For fire safety, three of the methylene chloride products were rated as extremely flammable and all alternatives were rated flammable.

## Cold Pipe Insulation

Cold pipe insulation products are aerosols or paints used on "cold pipes," such as air conditioning lines, refrigeration lines, to create a moisture barrier and eliminate condensation buildup resulting in sweating and dripping. Sprays are typically used in hard-to-reach areas or odd shaped fittings. There seems to be a limited market for these sprays and paints, as EPA identified few products to review. There are many other methods and products used to insulate cold pipes available, particularly for lengths of straight pipe, including flexible foam and mineral fiber insulation. Most products identified were sold in 15-ounce aerosol cans. However, this analysis also included two paint-on products available in liquid form and larger volumes as potential alternatives.

### Solvent Ingredients

EPA’s review of cold pipe insulation products identified one product containing methylene chloride. Four additional cold pipe insulation products contained trichloroethylene. EPA also reviewed one product containing alternative solvents, though limited information was available on the composition of this product. Table 5‑73 shows the list of products reviewed for this analysis and their primary solvent ingredients.

| Table 5‑73: Safety data sheets and solvent ingredients with concentrations 5% or higher for  reviewed cold pipe insulation products | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | SDS | SDS date | Solvent ingredients | Concentration (%) |
| Quest Specialty Corporation | Surround Cold Pipe Insulation Spray | <http://questspecialty.com/sds/5880_SDS_QS.pdf> | 07 February 2017 | Methylene Chloride | 30 - 60 |
| Brodi Specialty Products | Pipe Wrap | <https://www.brodi.com/index.php?route=product/sds/download&sds_id=276> | 08 June 2020 | Trichloroethylene | 30 - 60 |
| CPC | Terand Cold Pipe Insulation | <https://www.techno-ms.com/mt-content/uploads/2016/08/770-sds-cold-pipe.pdf> | 07 June 2015 | Trichloroethylene | 40 - 60 |
| Creative Chemical | Anti-Sweat 2.0 Cold Pipe Insulator Spray | [https://www.adcosupplies.com/index.php/product/anti-sweat-2-0-cold-pipe-insulation-spray-can/?attachment\_id=8879&download\_file=uiqa 0z5v5um](https://www.adcosupplies.com/index.php/product/anti-sweat-2-0-cold-pipe-insulation-spray-can/?attachment_id=8879&download_file=uiqar20z5v5um) | 28 July 2020 | Trichloroethylene | 25 - 50 |
| Sprayway | Sprayway Cold Pipe Insulation | <https://www.spraywayinc.com/sites/all/themes/theme687/msds/sw620.pdf> | 19 Nov 2020 | Trichloroethylene | 25 - <50 |
| Robson Thermal | No-Sweat FX | <https://www.dropbox.com/s/78pgtept3rud8gt/No%20Sweat%20FX%20MSDS%20long%20form.pdf?dl=0> | 3 September 2019 | Water-based  <https://www.dropbox.com/s/cnrq7jxhkz8pxu0/data%20sheet-no%20sweat-fx%20logo.pdf> | Not available |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

Table 5‑74 shows the estimated approximate market share percentage of primary solvents used in products estimated using the chemical ranking procedure. Water and trichloroethylene are currently the most used solvents in cold pipe insulation products. For the purpose of this analysis, EPA assumes that replacement products will not be formulated with priority chemicals with completed final risk evaluations. Thus, it is anticipated that water would be the most prevalent solvent used in replacement products.

| Table 5‑74: Estimated percentage share of solvent ingredients for reviewed cold pipe insulation products | | |
| --- | --- | --- |
| Solvent | Current market share | Projections for replacement products |
| Methylene Chloride | 19% | 0% |
| Trichloroethylene | 38% | 0% |
| Water | 43% | 100% |
| Other | 0% | 0% |
| Notes: The figures shown here are based on a proxy chemical ranking procedure, which draws upon factors including concentration in the product and availability and quality of product reviews. Orange shading indicates methylene chloride. Grey shading indicates another one of the first 10 TSCA work plan chemicals. Given the regulatory uncertainty while EPA considers risk management options for these chemicals, this analysis assumes any of the first 10 TSCA chemicals would not be adopted as alternative for methylene chloride while this regulatory uncertainty exists. | | |

### Volatile Organic Compounds (VOC) Content

EPA reviewed VOC information in product SDSs and summarized findings in Table 5‑75. No regulatory VOC limits for cold pipe insulation products were identified. Two of the products containing methylene chloride and trichloroethylene had VOC content data available: Terand Cold Pipe Insulation (87.8%) and Surround Cold Pipe Insulation Spray (32%). Only one alternative product had VOC content information: No-Sweat FX (60 g/ L). The density of the No Sweat FX product is not provided in the SDS, but it can be assumed that the density is approximately 1,000 g per liter since it is a water-based product. Therefore, the 60 g/L VOC content can be estimated as approximately 6% VOC which is much less than the VOC content for the Terand Cold Pipe Insulation (87.8%) and Surround Cold Pipe Insulation Spray (32%) products that methylene chloride.

| Table 5‑75: VOC content for cold pipe insulation products based on information in SDSs or technical data sheets | | |
| --- | --- | --- |
| Supplier | Product | VOC  (% weight, g/L) |
| Quest Specialty Corporation | Surround Cold Pipe Insulation Spray | 32% |
| Brodi Specialty Products | Pipe Wrap | No information in SDS |
| CPC | Terand Cold Pipe Insulation | 87.8% estimated |
| Creative Chemical | Anti-Sweat 2.0 Cold Pipe Insulator Spray | No information in SDS |
| Sprayway | Sprayway Cold Pipe Insulation | No information in SDS |
| Robson Thermal | No-Sweat FX | 60 g/ L |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | |

### Fire Safety

EPA reviewed flash points and flammability ratings in product SDSs and summarized findings in Table 5‑76. All five of the products containing target methylene chloride and trichloroethylene were rated extremely flammable or flammable. The anti-condensation coating, No-Sweat FX was rated non-flammable, and Permaseal Damp Proof Paint had no fire safety information in the SDS. Restricting target methylene chloride in this product category is unlikely to affect non-flammable options currently on the market. However, the cold pipe insulator product market seems to lack non-flammable options overall.

| Table 5‑76: Flash point and flammability ratings for cold pipe insulation products based on  information in SDSs or technical data sheets | | | |
| --- | --- | --- | --- |
| Supplier | Product | Flash Point | Flammability Rating |
| Quest Specialty Corporation | Surround Cold Pipe Insulation Spray | Not determined | Flammable aerosol |
| Brodi Specialty Products | Pipe Wrap | -156 °F (-104.4 °C) | Extremely flammable |
| CPC | Terand Cold Pipe Insulation | -156 °F (-104.4 °C) | Extremely flammable |
| Creative Chemical | Anti-Sweat 2.0 Cold Pipe Insulator Spray | Estimated -156 °F (‑104.4 °C) | Extremely flammable |
| Sprayway | Sprayway Cold Pipe Insulation | -156 °F (-104.4 °C) | Extremely flammable |
| Robson Thermal | No-Sweat FX | Not applicable | Non-flammable |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | |

### Pricing and Customer Reviews

EPA accessed pricing and customer review information on publicly available websites in August 2021 and summarized the findings in Table 5‑77. To assist in comparing prices across various products and product sizes, the prices were normalized to price per ounce. The methylene chloride cold pipe insulation spray was less expensive compared to the trichloroethylene containing products ($0.53 versus costs up to $2.35 per ounce). However, the alternative water-based product was similar in price to the methylene chloride product (also $0.53 per ounce).

Overall, it was difficult to compare customer satisfaction between products containing methylene chloride and alternative products due to lack of available information. Only one product, Anti-Sweat 2.0 Cold Pipe Insulator Spray, had customer rating information. The product was rated 5 out of 5 by one reviewer. Though no public reviews were available for alternative products, a representative at Roberson reported better performance and customer satisfaction with the water-based No-Sweat FX anti-condensation paint formula versus their original spray formula (No-Sweat Spray) containing methylene chloride. The Canada-based company formulated FX in response to government regulations on use of methylene chloride and discontinued production of the spray.

| Table 5‑77: Pricing and customer review information for cold pipe insulation products based on  manufacturer and retailer web pages | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | Retail information | Price per ounce | Customer ratings (out of 5) | Number of customer reviews |
| Quest Specialty Corporation | Surround Cold Pipe Insulation Spray | https://www.aerosolstore.com/questspecialty-surround-cold-pipe-insulation-spray.html | $0.53 | None | None |
| Brodi Specialty Products | Pipe Wrap | <https://www.brodi.com/pipewrap-anti-sweat-cold-pipe-spray-on-insulating-coating> | $2.35 | None | None |
| CPC | Terand Cold Pipe Insulation | <https://www.aerosolstore.com/terand-cold-pipe-insulation.html?gclid=CjwKCAjw95yJBhAgEiwAmRrutD9tb8j95CH6H1f0ZN1brbLTLtazMLtu1niaTJFB160Q6dTYVSmKhRoC2FsQAvD_BwE> | $0.63 | None | None |
| Creative Chemical | Anti-Sweat 2.0 Cold Pipe Insulator Spray | <https://www.adcosupplies.com/index.php/product/anti-sweat-2-0-cold-pipe-insulation-spray-can/> | $1.07 | 5 | 1 |
| Sprayway | Sprayway Cold Pipe Insulation | <https://www.aerosolstore.com/sprayway-cold-pipe-insulation.html> | $0.63 | None | None |
| Robson Thermal | No-Sweat FX | <http://www.robsonthermal.com/products-and-data-sheets#TOC-No-Sweat-FX-Anti-Condensation-Coating---Water-Base-> | $0.53 | None | None |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

### Conclusion

EPA did not find barriers around fire safety or pricing that may be caused by restricting use of methylene chloride in this product category. There was limited VOC information available for the products reviewed and based on this limited information it appears that replacement products can have less VOC content than products containing methylene chloride. Restricting methylene chloride in cold pipe insulation products is unlikely to affect non-flammable options on the market, as the only non-flammable option was a water-based alternative product. Most of the products in this review were rated extremely flammable. The pricing for the alternative product was similar to the methylene chloride product. Making a reliable comparison in customer satisfaction between product groups was not possible due to lack of available customer review information. One business representative reported greater customer satisfaction after reformulation to eliminate methylene chloride. It is reasonable to conclude technologically and economically viable alternatives exist in the marketplace.

## Anti-spatter Welding Aerosol

"Spatter" is a term used to describe droplets of molten material generated from gas metal arc welding. The spatter material can stick and harden when it unintentionally splashes on to work tables or other surfaces, and it is difficult remove. Anti-spatter coatings can be applied to welding projects, work areas, or welding torches or nozzles beforehand to prevent spatter from sticking to surfaces. Spatter that lands on areas coated with anti-spatter spray can be wiped or gently scrubbed clean. Anti-spatter coatings typically contain petroleum or water-based solvents, and are available in aerosol, liquid, or gel forms.

Anti-spatter products may be purchased for consumer use but seem to be available mainly through business-to-business retailers, such as Grainger and Airgas. Products found in this review were available in aerosol, liquid, or gel forms in volumes ranging from 14 ounces to 5 gallons. Larger volumes were also available on the market.

### Solvent Ingredients

The review included four products containing methylene chloride, one product containing perchloroethylene, and five products containing alternative solvents, including water, coconut diethanolamide, dimethylether, nonylphenoxypolyethoxyethanol, dimethyl ether, lactic acid, or triethanolamine. Table 5‑78 shows the list of products reviewed for this analysis and their primary solvent ingredients.

| Table 5‑78: Safety data sheets and solvent ingredients with concentrations 5% or higher for reviewed anti-spatter products | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | SDS | SDS date | Solvent ingredients | Concentration (%) |
| CANTESCO | Cantesco® Heavy Duty Solvent Based Anti-spatter | <https://www.cantesco.com/fileadmin/Products/Antispatter/CANTESCO%20HEAVY%20DUTY%20SOLVENT%20BASED%20ANTI-SPATTER/SDS_CANTESCO_HEAVY_DUTY_SOLVENT_BASED_ANTI-SPATTER_EN.pdf> | 01 May 2018 | Methylene Chloride | 60 - 100 |
| Weld-Aid | Heavy Duty Aerosol Spray Can | <http://docs.crcindustries.com/msds/1008284e.pdf> | 26 June 2019 | Methylene Chloride | 80 - 90 |
| High oleic safflower oil | 5 - 10 |
| CRC Industries, Inc. | NOZZLE-KLEEN® #2® | <http://docs.crcindustries.com/msds/1008283e.pdf> | 26 June 2019 | Methylene Chloride | 90 - 100 |
| High oleic safflower oil | 3 - 5 |
| Hot Max | Hot Max 23000 Anti-Spatter Spray, Silicone Free | <https://www.hotmaxtorches.com/download/msds/23000%20anti%20spatter%20msds.pdf> | 08 Oct 2013 | Methylene Chloride | 60 - 100 |
| Sprayon | WL™941 Dry Weld Spatter Protectant Aerosol | <https://www.paintdocs.com/docs/webpdf.jsp?siteid=so&doctype=sds&lang=en&prodno=075577759378&cntry=us> | 15 October 2020 | Perchloroethylene | ≥50 - ≤75 |
| Acetone | ≤10 |
| Weld-Aid | Heavy Duty Nozzle Dip HD gel | <https://weldaid.com/wp-content/uploads/2019/03/1008238e.pdf> | 19 June 2018 | Water  Water based gel:  <https://www.airgas.com/product/Welding-Products/Welding-Support-Equipment/Chemicals---Spatters-%26-Gels/p/WAP007094>  and https://weldaid.com/nozzle-kleen/ | 74% assumed  All other SDS ingredients total 26% |
| CRC Industries, Inc. | Welder's Anti Spatter | <http://docs.crcindustries.com/msds/1003349e.pdf> | 16 June 2015 | Water | 60 - 70 |
| Lactic acid | 5 - 10 |
| Radnor | Radnor Water Based Anti-Spatter (Aerosol) | <https://www.airgas.com/msds/004197.pdf> | 26 March 2019 | Water  In product name | 70%  Assumed  All other SDS ingredients total 30% |
| CRC Industries, Inc. | WELD-KLEEN® 350® Anti-Spatter | <https://weldaid.com/wp-content/uploads/2018/07/1008275e.pdf> | 04 May 2018 | Water | 90 - 100 |
| Simple Green | Simple Green Anti-Spatter | <https://cdn.simplegreen.com/downloads/sds_en-us_simplegreenantispatter.pdf> | 15 June 2021 | Water | > 90.1 |
| Triethanolamine | < 5 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

Table 5‑79 shows the anticipated, approximate market share percentage of primary solvents used in products estimated using the chemical ranking procedure. If restrictions were implemented for methylene chloride, then it is anticipated that water would be the most prevalent solvent used in replacement products.

| Table 5‑79: Estimated percentage share of solvent ingredients for reviewed anti spatter products | | |
| --- | --- | --- |
| Solvent | Anti-spatter Products  (current) | Anti-spatter products  (Projections for replacement products) |
| Methylene Chloride | 45% | 0% |
| Perchloroethylene | 5% | 0% |
| Water | 47% | 94% |
| High oleic safflower oil | 1% | 2% |
| Other | 3% | 6% |
| Notes: The figures shown here are based on a proxy chemical ranking procedure, which draws upon factors including concentration in the product and availability and quality of product reviews. Orange shading indicates methylene chloride. Grey shading indicates another one of the first 10 TSCA work plan chemicals. Given the regulatory uncertainty while EPA considers risk management options for these chemicals, this analysis assumes any of the first 10 TSCA chemicals would not be adopted as alternative for methylene chloride while this regulatory uncertainty exists. | | |

### Volatile Organic Compounds (VOC) Content

EPA reviewed VOC information in product SDSs and summarized findings are in Table 5‑80. There are no VOC regulations for anti-spatter products. Three of the four products containing methylene chloride, Cantesco Heavy Duty Solvent Based Anti-spatter, Heavy Duty Aerosol Spray Can, NOZZLE-KLEEN #2, had VOC content of 0%. Two of the alternative products had VOC information: Radnor Water Based Anti-Spatter, made with dimethylether and nonylphenoxypolyethoxyethanol, had the lowest VOC content of all products with VOC information at 18.29%. Welder's Anti Spatter had VOC content of 25.3%. Weld-Kleen 350 and Simple Green Anti-spatter did not have VOC information. However, both of these products are made with at least 90% water and likely to have low VOC content. If methylene chloride was restricted in this product type, other products exist on the market with VOC content below 30%.

| Table 5‑80: VOC content for anti-spatter products based on information in SDSs or technical data sheets | | |
| --- | --- | --- |
| Supplier | Product | VOC  (% weight, g/L) |
| CANTESCO | Cantesco Heavy Duty Solvent Based Anti-spatter | 0% |
| Weld-Aid | Heavy Duty Aerosol Spray Can | 0% |
| CRC Industries, Inc. | NOZZLE-KLEEN #2 | 0% |
| Hot Max | Hot Max 23000 Anti-Spatter Spray, Silicone Free | 90% |
| Sprayon | WL 941 Dry Weld Spatter Protectant Aerosol | No information in SDS |
| Weld-Aid | Heavy Duty Nozzle Dip HD gel | No information in SDS |
| CRC Industries, Inc. | Welder's Anti Spatter | 25.3% |
| Radnor | Radnor Water Based Anti-Spatter (Aerosol) | 18.29% |
| CRC Industries, Inc. | WELD-KLEEN 350 Anti-Spatter | No information in SDS |
| Simple Green | Simple Green Anti-Spatter | No information in SDS |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | |

### Fire Safety

EPA reviewed flash points and flammability ratings in product SDSs and summarized findings in Table 5‑81. All products containing methylene chloride were rated as non-flammable. Sprayon, containing perchloroethylene and acetone, and the alternative product, Radnor Water Based Anti-Spatter made with dimethylether and nonylphenoxypolyethoxyethanol, were both rated as extremely flammable. All other products containing target solvents or alternative solvents had a non-flammable rating. Based on the product reviews, restricting methylene chloride in anti-spatter products is unlikely to affect availability of non-flammable products on the market.

| Table 5‑81: Flash point and flammability ratings for anti-spatter products based on information  in SDSs or technical data sheets | | | |
| --- | --- | --- | --- |
| Supplier | Product | Flash Point | Flammability Rating |
| CANTESCO | Cantesco Heavy Duty Solvent Based Anti-spatter | Flash point not available | Non-flammable |
| Weld-Aid | Heavy Duty Aerosol Spray Can | None | Non-flammable |
| CRC Industries, Inc. | NOZZLE-KLEEN #2 | None | Non-flammable |
| Hot Max | Hot Max 23000 Anti-Spatter Spray, Silicone Free | Not applicable | Non-flammable |
| Sprayon | WL 941 Dry Weld Spatter Protectant Aerosol | -20.2°F (-29°C) | Extremely flammable |
| Weld-Aid | Heavy Duty Nozzle Dip HD gel | > 201 °F (> 93.9 °C) | Non-flammable |
| CRC Industries, Inc. | Welder's Anti Spatter | > 265 °F (> 129.4 °C) | Non-flammable |
| Radnor | Radnor Water Based Anti-Spatter (Aerosol) | -42 °F (-41.1 °C) | Extremely flammable |
| CRC Industries, Inc. | WELD-KLEEN 350 Anti-Spatter | 212 °F (100 °C) | Non-flammable |
| Simple Green | Simple Green Anti-Spatter | > 212 °F | Non-flammable |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | |

### Pricing and Customer Reviews

EPA accessed pricing and customer review information on publicly available websites in July 2021 and summarized the findings in Table 5‑82. To assist in comparing prices across various products and product sizes, the prices were normalized to price per ounce. Prices for products containing methylene chloride ranged from $0.51 (Heavy Duty Aerosol Spray Can) to $1.13 per ounce (Hot Max 23000 Anti-Spatter Spray, Silicone Free). Prices for alternative products ranged from $0.13 per ounce (Weld Kleen 350 Anti-Spatter) to $0.83 per ounce (Welder's Anti Spatter). Weld Kleen 350 Anti-Spatter was sold in a larger volume than all other products (5 gallons), which likely affected the price per ounce. However, a 14-ounce container of Simple Green Anti-Spatter had the next lowest price of the alternative products at $0.18 per ounce.

Only four of the 10 products reviewed had customer ratings. Two methylene chloride products, Cantesco Heavy Duty Solvent Based Anti-spatter and Hot Max 23000 Anti-Spatter Spray, had customer ratings of 4.6 and 4.2 respectively based on a 5 star rating system. There were no customer ratings available for the perchloroethylene product. The two rated products with non-priority chemical alternative solvents, Heavy Duty Nozzle Dip HD gel and Simple Green Anti-Spatter, had ratings of 4.5 and 4.1 respectively. Based on the limited customer rating information, products containing alternative solvents may have similar customer satisfaction as products containing methylene chloride.

| Table 5‑82: Pricing and customer review information for anti-spatter products based on manufacturer and retailer web pages | | | | | |
| --- | --- | --- | --- | --- | --- |
| Supplier | Product | Retail information | Price per ounce | Customer ratings (out of 5) | Number of customer reviews |
| CANTESCO | Cantesco Heavy Duty Solvent Based Anti-spatter | <https://www.amazon.com/CANTESCO-AS-16-Solvent-Anti-Spatter-Aerosol/dp/B008BJCY1K> | $0.55 | 4.6 | 314 |
| Weld-Aid | Heavy Duty Aerosol Spray Can | <https://www.grainger.com/product/24A416> | $0.51 | None | None |
| CRC Industries, Inc. | NOZZLE-KLEEN #2 | <https://www.airgas.com/product/Welding-Products/Welding-Support-Equipment/Chemicals---Spatters-%26-Gels/p/WAP007022> | $0.56 | None | None |
| Hot Max | Hot Max 23000 Anti-Spatter Spray, Silicone Free | <https://www.amazon.com/Hot-Max-23000-Anti-Spatter-Silicone/dp/B005UUQJD2> | $1.13 | 4.2 | 24 |
| Sprayon | WL 941 Dry Weld Spatter Protectant Aerosol | <https://www.grainger.com/product/6KDT4> | $0.49 | None | None |
| Weld-Aid | Heavy Duty Nozzle Dip HD gel | <https://www.grainger.com/product/24A413> | $0.52 | 4.5 | 895 |
| CRC Industries, Inc. | Welder's Anti Spatter | <https://www.grainger.com/product/2F137> | $0.83 | None | None |
| Radnor | Radnor Water Based Anti-Spatter (Aerosol) | <https://www.airgas.com/product/Welding-Products/Welding-Support-Equipment/Chemicals---Spatters-%26-Gels/p/RAD64000110> | $0.41 | None | None |
| CRC Industries, Inc. | WELD-KLEEN 350 Anti-Spatter | <https://www.amazon.com/Weld-Aid-Weld-Kleen-350-Anti-Spatter-Liquid/dp/B008RA5H76> | $0.13 | None | None |
| Simple Green | Simple Green Anti-Spatter | <https://www.amazon.com/Simple-Green-1410000413454-Anti-Spatters-Clear/dp/B00IHGOJ3I> | $0.18 | 4.1 | 70 |
| Note: Orange shaded rows indicate products that contain methylene chloride. Grey shaded rows indicate products that contain another one of the first 10 TSCA work plan chemicals. | | | | | |

### Conclusion

The market review of anti-spatter products included products containing methylene chloride, and a variety of alternative solvents. EPA did not find barriers around VOC, fire safety, or pricing that may be caused by restricting use of methylene chloride in this product category. Some products with alternative solvents had similar VOC content to those products with target solvents. There were at least two alternative products on the market with a VOC content below 30%. The products containing at least 90% water were likely to have low VOC content as well. Most of the products reviewed were rated non-flammable. The price range per ounce of products containing alternative solvents was lower than that of products with methylene chloride. Customer ratings were limited, but were similar between products containing target solvents and products containing alternative solvents. Therefore, there are technologically and economically viable alternatives in the marketplace.

# Baseline Analysis

This chapter presents the estimated baseline consumption levels for methylene chloride (section 6.1) and the estimated number of firms as well as occupational and consumer users of methylene chloride and methylene chloride products (section 6.2). The estimated numbers of firms and individuals affected under the rule presented in this chapter are used to estimate the number of firms with cost impacts attributable to the options and the number of individuals expected to benefit from reduced exposures under the options.

## Baseline Methylene Chloride Consumption Volumes by Use Category

This section presents estimates of the amount of methylene chloride consumed for most use categories considered in the economic analysis. EPA used several sources to derive the estimates, which differ according to the type of emission source associated with the use category. Figure 6‑1 presents an overview of the approach to estimating the methylene chloride consumption volume associated with each use category.

|  |
| --- |
| Figure 6‑1: Overview of Approach |
|  |

### Point Sources

The analysis uses emissions estimates reported by the 2017 National Emissions Inventory (NEI) ([EPA 2020a](#_ENREF_96)) to estimate methylene chloride consumption for the following use categories:

* Cellulose Triacetate Film Production
* Vapor Degreasing
* Batch Cold Cleaning (Liquid Cleaners and Degreasers)

The approach for these uses consisted of the following steps:

* Estimate an emissions factor for each use category in order to convert NEI emissions estimates to consumption estimates
* Map NEI submissions to use categories
* Sum total NEI emissions by use category
* Divide emissions from (3) by the emissions factor from (1) to estimate methylene chloride consumption for each use category

The first step is to estimate an emissions factor that will allow for the conversion of methylene chloride emissions to methylene chloride consumption. These emission factors are presented in Table 6‑1. While many NEI submitters reported the emissions factors they used to generate their emissions estimates, EPA was not able to use these reported factors because the units were not provided. However, some NEI submitters reported the input quantities (*e.g.*, tons solvent used) that they used to calculate their emissions. In these cases, reported emissions (Table 6‑1; Column B) were divided by the input quantity (Table 6‑1; Column A) to estimate an emissions factor. EPA also conducted a search for other sources with published emissions factors, which are presented in Table 6‑1 as well.

The emissions factors in Table 6‑1 vary widely, as they are affected by differences in equipment, process, and control technologies. Because the type of equipment and controls used by both the NEI submitters and the industries at large is not reported, the analysis uses the average of the identified emissions factors for the analysis estimates.

| Table 6‑1: Methylene Chloride Emission Factors | | | | |
| --- | --- | --- | --- | --- |
| Calculation Input Quantity | Total emissions (lb) | Emission Factor | Emission Factor  (lb emitted/lb solvent) | Source |
| A | B | B ÷ A |
| Cellulose Triacetate Film Production | | | | |
| - | - | - | 1.000 | [EPA 1995](#_ENREF_82); Table 1-1 |
| **Average Cellulose Triacetate Film Production** | | | 1.000 |  |
| Vapor Degreasing | | | | |
| 121 ton solvent | 55,180 | 457 lb/ton | 0.228 | [EPA 2020a](#_ENREF_96) |
| 9 ton solvent | 18,240 | 2,000 lb/ton | 1.000 |
| 292 gal solvent | 3,236 | 11 lb/gal | 1.001 |
| 1611 gal solvent | 17,850 | 11 lb/gal | 1.001 |
| 110 gal solvent | 1,219 | 11 lb/gal | 1.001 |
| 1836 gal solvent | 20,340 | 11 lb/gal | 1.001 |
| 56 gal solvent | 620 | 11 lb/gal | 1.001 |
| 1077 gal solvent | 11,934 | 11 lb/gal | 1.001 |
| 804 gal solvent | 8,908 | 11 lb/gal | 1.001 |
| 3 ton solvent | 5,701 | 1,662 lb/ton | 0.831 |
| - | - | 1 kg/kg solvent used | 0.855 | EPA emissions factor for OTVD; uncontrolled ([EPA 2020k](#_ENREF_106)) |
| - | - | 1 kg/kg solvent used | 0.890 | EPA emissions factor for OTVD; freeboard refrigeration device ([EPA 2020k](#_ENREF_106)) |
| - | - | 1 kg/kg solvent used | 0.905 | EPA emissions factor for CVD; uncontrolled ([EPA 2020k](#_ENREF_106)) |
| - | - | 1 kg/kg make-up solvent used | 0.910 | EPA emissions factor for CVD; activated carbon adsorption ([EPA 2020k](#_ENREF_106)) |
| **Average Vapor Degreasing** | | | 0.902 |  |
| Batch Cold Cleaning (Liquid Cleaners and Degreasers) | | | | |
| 1 ton solvent | 1,268 | 1,510 lb/ton | 0.755 | [EPA 2020a](#_ENREF_96) |
| 11 ton solvent | 22,213 | 2,000 lb/ton | 1.000 |
| 22 ton solvent | 44,427 | 2,000 lb/ton | 1.000 |
| 22 ton solvent | 44,427 | 2,000 lb/ton | 1.000 |
| 8 ton solvent | 5,250 | 651 lb/ton | 0.325 |
| 46 ton solvent | 280 | 6 lb/ton | 0.003 |
| 0.13 ton solvent | 260 | 2,000 lb/ton | 1.000 |
| 0.03 ton solvent | 1 | 20 lb/ton | 0.010 |
| 27 ton solvent | 53,140 | 2,000 lb/ton | 1.000 |
| 26 ton solvent | 300 | 12 lb/ton | 0.006 |
| 4273 lb Methylene Chloride | 4,280 | 1 lb/lb | 1.002 |
| - | - | 1,800 lb/tons solvent consumed | 0.900 | EPA emissions factor for cold solvent cleaning/stripping; Methylene Chloride; uncontrolled ([EPA 2020k](#_ENREF_106)) |
| - | - | 1 lb/lb solvent used | 0.775 |
| - | - | 1 kg/kg solvent used | 0.780 | EPA emissions factor for cold solvent cleaning/stripping; Methylene Chloride; activated carbon adsorption ([EPA 2020k](#_ENREF_106)) |
| **Average Cold Cleaning** | | | 0.683 |  |

The next step is to categorize each of the NEI submissions into a use category. EPA assigned the most likely use to each facility based on the NAICS, unit type, unit description, process description, and source classification codes reported. In some cases, the use category could not be determined based on the reported information. These emissions were reallocated based on the following assumptions:

* Uses in the pulp, paper, and wood products sector are allocated to cold cleaning
* Unspecified point source cleaning/degreasing uses are allocated to vapor degreasing, cold cleaning, and paint stripping uses, proportional to the identified point source emissions for those uses.
  + Note that while paint stripping uses are not included in this section (see discussion in section 6.1.2), they are included for the purposes of the reallocation calculations
* Unknown point sources are allocated to each use, proportional to their identified point source emissions
  + Again, while certain uses reported in NEI are excluded from this section, they are included for the purposes of the reallocation calculations
* Finally, the emissions by use category are summed and then divided by the emissions factors from Table 6‑1 to estimate methylene chloride consumption for the point sources.

#### Summary and Discussion

Table 6‑2 presents the methylene chloride consumption estimates for the six use categories expected to be primarily comprised of only point sources in industrial settings.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 6‑2: Point Source Annual Volume of Methylene Chloride Consumed | | | |
| Use Category | Total Emissions (lbs)1 | Average Emissions Factor (lb emissions/lb consumption)2 | Consumption (lbs) |
| A | B | A ÷ B |
| Cellulose Triacetate Film Production | 3,952 | 1.00 | 3,952 |
| Vapor Degreasing | 295,014 | 0.90 | 327,126 |
| Batch Cold Cleaning (Liquid Cleaners and Degreasers) | 829,107 | 0.68 | 1,214,743 |
| 1 Source: [EPA 2020a](#_ENREF_96)  2 Source: Table 6‑1 | | | |

The limitations of this approach include the following:

* There is some uncertainty around the emissions factors. As previously discussed, the type of control technologies users have implemented is not known and how the calculated emissions factors relate to those controls is also not known. Furthermore, for some uses, an emissions factor could not be identified or the only identified emissions factors were older and potentially outdated factors.
* Due to the subjective nature of mapping NEI reports to use categories, some irrelevant emissions sources may have been inadvertently included and/or relevant emissions sources may have been inadvertently excluded.
* Given NEI reporting requirements, point source methylene chloride emissions are likely under-reported. Methylene chloride is not required to be reported to NEI, although some states voluntarily do report. For the industries where EPA expects methylene chloride to be reported but it is not, EPA applies a scaling factor to reported emissions to best estimate a complete inventory of methylene chloride emissions ([EPA 2020b](#_ENREF_97)). However, EPA only applies this scaling to cold cleaning point sources, such that emissions estimates for the remaining point source sectors are comprised solely of voluntary reports ([EPA 2020g](#_ENREF_102)).

### Point and Non-Point Sources

This section estimates use volumes for the following use categories that EPA believes are emitted from both point and nonpoint sources:

* Liquid Cleaners and Degreasers
* Aerosol Spray Cleaning/Degreasing
* Paint and Coating Removers
* Adhesive and Caulk Remover
* Dry Cleaning and Spot Removers
* Paint and Coatings
* Glues, Sealants, Adhesives, and Caulks
* Lubricants and Greases
* Cold Pipe Insulation
* Anti-Spatter Welding Aerosol

While many of these uses are reported in NEI as point and/or nonpoint sources, this analysis uses a different approach to estimate the consumption volumes than that described in the previous section because NEI may significantly underestimate nonpoint emissions of methylene chloride. As with the point sources, nonpoint emissions of methylene chloride and other hazardous air pollutants are not required to be reported to NEI, although states may voluntarily do so. EPA thus produces its own national emissions estimates for those pollutants that are included on its Expected Pollutant List, which lists the pollutants EPA expects to observe for each use. If a state submits a pollutant that is not on the list for a given use, EPA will remove it unless the state provides documentation supporting its submission ([EPA 2020b](#_ENREF_97)). Of the relevant use categories, EPA only lists methylene chloride as an expected nonpoint pollutant for degreasing uses ([EPA 2020h](#_ENREF_103)). Thus, all nonpoint emissions of methylene chloride reported in NEI that are not degreasing (*e.g.*, paints and coatings, adhesives and sealants) only reflect voluntary submissions by states that provided documentation.

This analysis follows NEI’s general approach for estimating nonpoint source emissions of methylene chloride, but accounts for the uses that NEI does not. This approach methodology is described below.

#### Methodology

The analysis approach for these uses consisted of the following steps:

1. Estimate total solvent usage
2. Allocate total solvent usage to relevant use categories
3. Apply methylene chloride speciation factors to approximate the market share of methylene chloride in each use category

**Step 1: Estimate total solvent usage**

NEI bases its estimates on national-level projections of solvent usage from the Freedonia Group ([The Freedonia Group 2016](#_ENREF_66)), which are reproduced in Table 6‑3 below. These estimates encompass both point and nonpoint sources.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 6‑3: Solvent Usage in the U.S. | | | |
| Description | Solvent Usage (Million Pounds) | | |
| 2015 | 2017 | 2020 |
| Paints & Coatings Solvent Demand: Architectural | 735 | 777 | 840 |
| Paints & Coatings Solvent Demand: Other | 1,318 | 1,321 | 1,325 |
| Printing Ink Solvent Demand | 1,132 | 1,134 | 1,138 |
| Cleaning Products Solvent Demand: Household | 653 | 657 | 662 |
| Cleaning Products Solvent Demand: Industrial & Institutional | 385 | 390 | 398 |
| Cosmetics & Toiletries Solvent Demand | 628 | 645 | 670 |
| Adhesives & Sealants Solvent Demand | 572 | 600 | 643 |
| Transportation Solvent Demand: Motor Vehicles | 61 | 62 | 64 |
| Dry Cleaning | 20 | 18 | 16 |
| Source: [The Freedonia Group 2016](#_ENREF_66) | | | |

**Step 2: Allocate total solvent usage to relevant use categories**

Because the Freedonia solvent categories in Table 6‑3 are broader than the use categories, they need to be disaggregated into the consumption volumes of the constituent use categories. Table 6‑4 provides a crosswalk of the use categories with the Freedonia categories.

This analysis uses the California Air Resources Board (CARB)’s 2015 Consumer and Commercial Product Survey to estimate the market share of each use category within the Freedonia categories ([CARB 2019b](#_ENREF_11)). CARB’s survey reports consumer and commercial product sales volumes for over 400 categories of products. The survey was mandatory for consumer product manufacturers, and reflects reports of approximately 1,400 companies and over one million products ([CARB 2019a](#_ENREF_10)). EPA mapped the product categories in the CARB survey data to both the Freedonia categories and the use categories. Note that the analysis includes any CARB product category EPA determined might reasonably include any solvent, not just methylene chloride. Based on the total sales weight (lbs) of each CARB product category, the analysis then estimates the market share of each use category as a percentage of the Freedonia solvent category. Multiplying the market share by the total solvent consumption from Table 6‑3 yields total solvent demand by use category, shown in Table 6‑4 below.

| Table 6‑4: Total Use Category Annual Solvent Demand | | | | |
| --- | --- | --- | --- | --- |
| Use Category | Freedonia Solvent Category | 2020 Total Solvent Demand (million lbs)1 | Market Share of Solvent Category (%wt)2 | Total Use Category Solvent Demand (million lbs) |
| A | B | A X B |
| Liquid Cleaners and Degreasers | Cleaning Products Solvent Demand: Household | 662 | 0.073 | 48 |
| Dry Cleaning and Spot Removers | 0.049 | 32 |
| Aerosol Spray Cleaning/Degreasing | Transportation Solvent Demand: Motor Vehicles | 64 | 1.000 | 64 |
| Glues, Sealants, Adhesives, and Caulks | Adhesives & Sealants Solvent Demand | 643 | 0.984 | 633 |
| Adhesive and Caulk Remover | 0.002 | 1 |
| Cold Pipe Insulation | 0.016 | 10 |
| Paint and Coatings | Paints & Coatings Solvent Demand: Architectural | 840 | 1.000 | 840 |
| Paint and Coating Removers | Paints & Coatings Solvent Demand: Other | 1,325 | 0.072 | 95 |
| Paint and Coatings | 0.190 | 252 |
| Lubricants and Greases | 0.416 | 551 |
| Anti-Spatter Welding Aerosol | 0.006 | 7 |
| *1 Source*: [The Freedonia Group 2016](#_ENREF_66)  2 *Source*: [CARB 2019b](#_ENREF_11) | | | | |

**Step 3: Apply methylene chloride speciation factors to approximate the market share of methylene chloride in each Use Category**

This analysis follows NEI’s approach by applying a speciation factor to the Freedonia solvent usage estimates to estimate methylene chloride usage. The speciation factors are the estimates of the percentage of total volatiles that methylene chloride constitutes. However, the underlying implication of NEI’s approach is that the methylene chloride speciation factors are also a proxy for methylene chloride’s market share of total solvent usage.[[14]](#footnote-16) The analysis uses speciation factors from EPA’s SPECIATE database, which is a repository of speciation factors of air pollutant sources ([EPA 2020j](#_ENREF_105)). The database contains approximately 150 speciation profiles for methylene chloride, which are mapped to the use categories (Table 6‑5). The last column of Table 6‑5 includes the CARB and NEI descriptive names for the product or use that the speciation factor represents (The CARB descriptive names include “CARB” in the profile code and the NEI names are associated with 4-digit profile codes).

The methylene chloride profiles in the SPECIATE database are dated from 1994-2018, and may cover a range of values for the same use category. In particular, there is a group of about 20 profiles corresponding to CARB’s consumer product categories from 2018, and a group of equivalent profiles from 2004. The 2018 estimates are significantly lower than the 2004 factors, which is the result of the regulations CARB implemented in the intervening years that prohibit use of methylene chloride in a range of consumer product categories ([CARB 2019c](#_ENREF_12)). Where possible, EPA therefore uses CARB’s 2018 factors for states that regulate methylene chloride in a given use and CARB’s 2004 factors for states that do not have methylene chloride regulations. Table 6‑5 presents these speciation factors for each use category.

| Table 6‑5: Methylene Chloride Speciation Factors | | | |
| --- | --- | --- | --- |
| Use Category | Speciation Factor  (Weight %) | | Methylene Chloride Speciation Factor Profile Names (Profile Code) |
| State Limit | No State Limit |
| Liquid Cleaners and Degreasers | 3.50 | 12.40 | CONS PRD- OTHER CLEANERS AND DEGREASERS (2010 UPDATE) (CARB3098)  Degreasing - Hand wiping (3187) |
| Aerosol Spray Cleaning/Degreasing (Brake Cleaner) | 0.01 | 2.32 | CONS PRD- AUTOMOTIVE BRAKE CLEANER (2010 UPDATE) (CARB3012)  Consumer Products: Automotive Brake Cleaners (3028) |
| Aerosol Spray Cleaning/Degreasing (Carburetor or Fuel-Injection Air Intake Cleaner; Carbon Remover) | 0.84 | 3.62 | CONS PRD- CARBURETOR OR FUEL-INJECTION AIR INTAKE CLEANER (2010 UPDATE) (CARB3013)  Consumer Products: Carburetor Or Fuel-Injection Air Intake Cleaners (3029) |
| Aerosol Spray Cleaning/Degreasing (Engine Degreaser) | 0.84 | 3.62 | CONS PRD- CARBURETOR OR FUEL-INJECTION AIR INTAKE CLEANER (2010 UPDATE) (CARB3013)  Consumer Products: Carburetor Or Fuel-Injection Air Intake Cleaners (3029) |
| Paint and Coating Removers | 0.66 | 66.00 | Paint and Coating Removers (CARB3018)1 |
| Adhesive and Caulk Remover | 0.02 | 7.50 | CONS PRD- ALL OTHER ADHESIVES (2010 UPDATE) (CARB3096)  Consumer Products: Adhesive Remover (3042) |
| Dry Cleaning and Spot Removers | 0.003 | 0.30 | Consumer Products: Spot Removers - Non-Aerosols (3063)2 |
| Paint and Coatings (Architectural) | 0.45 | 0.45 | 2004 Architectural Coatings - solvent based - 2005 survey (CARB3901)2 |
| Paint and Coatings (Other) | 0.45 | 0.45 | Composite Profile - Architectural Coatings: Solvent Borne and water borne (CARB3901)3 |
| Glues, Sealants, Adhesives, and Caulks | 0.06 | 1.09 | Consumer and Commercial Products – Adhesives and Sealants Composite CARB 2010 Survey Update (95507)  Consumer Products Composite: Adhesives And Sealants (3142) |
| Lubricants and Greases | 0.08 | 0.41 | CONS PRD- SPECIAL PURPOSE LUBRICANT (2010 UPDATE) (CARB3061)  Consumer Products: Multipurpose Lubricant (3089) |
| Cold Pipe Insulation | 0.03 | 3.73 | CONS PRD- INSULATING AND SEALING FOAM (2010 UPDATE) (CARB3084)  Consumer Products: Aerosol Adhesive (Including Industrial) (3010) |
| Anti-spatter Welding Aerosol | 0.08 | 0.41 | CONS PRD- SPECIAL PURPOSE LUBRICANT (2010 UPDATE) (CARB3061)  Consumer Products: Multipurpose Lubricant (3089) |
| *Source*: [EPA 2020j](#_ENREF_105)  1 The speciation factor for paint strippers in the 2010 CARB update was later than that in the 2004 submission. Therefore, the 2010 speciation factor is assigned to the states without a methylene chloride limit, and assumed that the speciation factor for states with a methylene chloride limit is 1% of the factor for the states without a methylene chloride limit.  2 No speciation factor for spot removers was identified in the 2010 CARB update. Therefore, it is assumed that the speciation factor for states with a methylene chloride limit would be 1% of the factor for states without a methylene chloride limit.  3 While state limits on paint thinners were identified, no states limiting using of other types of paints and coatings were identified. Because methylene chloride is not present in paint thinners, only a single speciation factor for paints and coatings is used. | | | |

Table 6‑6 summarizes the states that limit methylene chloride use. The analysis included states from [ISSA (2018)](#_ENREF_33) that regulate methylene chloride for certain uses, as well as states that NEI identified as having VOC limits ([EPA 2020b](#_ENREF_97)). Note that while some states may have VOC limits for certain product categories, methylene chloride is an exempt VOC under EPA’s definition. Therefore, Table 6‑6 only includes states EPA verified as defining methylene chloride as a VOC or that passed separate regulations that specifically limit methylene chloride.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 6‑6: States with Regulations Limiting Methylene Chloride Emissions in Consumer Products | | | | | | | | | | | | |
| State | Product Category1 | | | | | | | | | | | |
| AD | ADR | SR | ASD | LG | PC | PCR | SC/SD | CR | BC/PT | WFC | AFC |
| California | ✓ | ✓ | ✓ | ✓ | ✓ |  | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Connecticut | ✓ | ✓ |  | ✓ |  |  |  | ✓ |  |  |  | ✓ |
| Delaware | ✓ | ✓ | ✓ | ✓ | ✓ |  | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| District of Columbia | ✓ | ✓ |  | ✓ |  |  |  |  |  |  |  | ✓ |
| Illinois | ✓ | ✓ |  | ✓ |  |  |  | ✓ |  |  |  | ✓ |
| Indiana | ✓ | ✓ |  | ✓ |  |  |  | ✓ |  |  |  | ✓ |
| Maine | ✓ | ✓ |  | ✓ |  |  |  | ✓ |  |  |  | ✓ |
| Maryland | ✓ | ✓ |  |  |  |  |  | ✓ | ✓ |  |  | ✓ |
| Massachusetts | ✓ | ✓ |  | ✓ |  |  |  | ✓ |  |  |  | ✓ |
| Michigan | ✓ | ✓ |  | ✓ |  |  |  | ✓ |  |  |  | ✓ |
| New Hampshire | ✓ |  |  |  |  |  |  | ✓ |  |  |  |  |
| New Jersey | ✓ | ✓ |  | ✓ |  |  |  | ✓ |  |  |  | ✓ |
| New York | ✓ | ✓ |  | ✓ |  |  |  | ✓ |  |  |  | ✓ |
| Rhode Island | ✓ | ✓ |  | ✓ |  |  |  | ✓ |  |  |  | ✓ |
| Virginia | ✓ |  |  |  |  |  |  |  |  |  |  |  |
| *Source*: [ISSA 2018](#_ENREF_33); [EPA 2020b](#_ENREF_97)  1 AD = Adhesives; ADR = Adhesive Removers; SR = Spot Removers; ASD = Aerosol Spray Degreasers; LG = Lubricants and Greases; PC = Paint and Coatings; PCR = Paint and Coating Removers; SC/SD = Solvent Cleaners/Degreasers; CR = Carbon Removers; BC/PT = Brush Cleaners/Paint Thinners; WFC = Wood Floor Cleaners; AFC = Apparel and Footwear Care Products | | | | | | | | | | | | |

#### Summary and Discussion

Table 6‑7 summarizes the methylene chloride consumption estimates for the use categories discussed in this section. Note that the speciation factors are weighted by the populations of the states with and without methylene chloride limits. These population weights are derived from the 2018 American Community Survey ([U.S. Census Bureau 2019](#_ENREF_77)).

Some limitations of this approach include the following:

1. The Freedonia 2020 solvent usage projections were made in 2016. While they may have attempted to account for foreseeable changes in the market for solvents, they likely could not have fully accounted for the regulatory and industry trends in the last five years. Their predictions therefore may not reflect the actual solvent market in 2020.
2. The analysis relies on CARB’s 2015 consumer and commercial product survey to estimate the market share of each use category. This necessitates several assumptions:

* That the market share of products in California reflect those of the entire U.S.
* That the market share of consumer and commercial products also reflects the market share of industrial products
* That the sales volumes of products omitted from the survey data for confidentiality reasons are negligible
* That the sales volumes of the overall products are proportional to the volumes of solvent used

1. The analysis uses the speciation factors as a proxy for methylene chloride’s share of the solvent market, but this may be inaccurate to the extent that product categories are largely comprised of non-solvent alternatives (*i.e.,* methylene chloride may be a small share of total volatile emissions, but a larger share of solvent emissions/use)
2. These estimates do not account for the 2019 paint and coating remover rule. While EPA could use the “State methylene chloride limit” speciation factor for all states, it is not known whether that speciation factor would reflect continued paint stripper use in commercial and industrial sectors. It’s therefore likely that these estimates for the paint and coating remover use category are overestimated.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Table 6‑7: Non-Point Sources Annual Volume of Methylene Chloride Consumed | | | | | | |
| Use Category | Total Use Category Solvent Demand (million lbs) | State Limit | | No State Limit | | Annual Volume Consumed (lbs) |
| Speciation Factor (Weight %) | State Population Weight | Speciation Factor (Weight %) | State Population Weight |
| A | B | C | D | E | A x (0.01\*B\*C + 0.01\*D\*E) x 1,000,000 |
| Liquid Cleaners and Degreasers | 48 | 3.50 | 0.36 | 12.40 | 0.64 | 4,422,558 |
| Aerosol Spray Cleaning/Degreasing (Brake Cleaner) | 13 | 0.01 | 0.34 | 2.32 | 0.66 | 203,675 |
| Aerosol Spray Cleaning/Degreasing (Carburetor or Fuel-Injection Air Intake Cleaner; Carbon Remover) | 3 | 0.84 | 0.34 | 3.62 | 0.66 | 80,990 |
| Aerosol Spray Cleaning/Degreasing (Engine Degreaser) | 48 | 0.84 | 0.34 | 3.62 | 0.66 | 1,271,520 |
| Paint and Coating Removers | 95 | 0.66 | 0.12 | 66.00 | 0.88 | 54,877,568 |
| Adhesive and Caulk Remover | 1 | 0.02 | 0.36 | 7.50 | 0.64 | 51,466 |
| Dry Cleaning and Spot Removers | 32 | 0.003 | 0.12 | 0.30 | 0.88 | 85,498 |
| Paint and Coatings (Architectural) | 840 | 0.45 | 0.13 | 0.45 | 0.87 | 3,780,000 |
| Paint and Coatings (Other) | 252 | 0.45 | 0.13 | 0.45 | 0.87 | 1,132,737 |
| Glues, Sealants, Adhesives, and Caulks | 633 | 0.06 | 0.39 | 1.09 | 0.61 | 4,349,104 |
| Lubricants and Greases | 551 | 0.08 | 0.12 | 0.41 | 0.88 | 2,037,131 |
| Cold Pipe Insulation | 10 | 0.03 | 0.39 | 3.73 | 0.61 | 234,317 |
| Anti-spatter Welding Aerosol | 7 | 0.08 | 0.13 | 0.41 | 0.87 | 27,054 |

### Lithographic Printing Cleaner

EPA identified about ten sites reporting methylene chloride emissions related to lithographic printing in the NEI data. However, [Sutton, Wolf et al. (2009)](#_ENREF_65) estimate that there are approximately 44,500 to 54,000 lithographic printers in the U.S. It is possible that the printers reported by NEI are the only ones using methylene chloride, but since the NEI may under-report methylene chloride emissions (as discussed in the previous sections), EPA thinks it is likely that NEI does not include all lithographic printers.

Thus, the analysis instead uses estimates from [Sutton, Wolf et al. (2009)](#_ENREF_65), as shown in Table 6‑8. Note that the estimate for the percent of products using methylene chloride (parameter D in Table 6‑8) is an assumption EPA made, as it was not reported by [Sutton, Wolf et al. (2009)](#_ENREF_65). [Sutton, Wolf et al. (2009)](#_ENREF_65) did list ingredients from 20 SDSs compiled from cleaner products used by printers participating in the study, and methylene chloride was only included in one SDS, so it does not appear to be a common solvent.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 6‑8: Lithographic Printing Cleaners - Annual Volume of Methylene Chloride Consumed | | | | |
| Parameter | Calculation | Low Estimate | Median Estimate | High Estimate |
| Number of lithographic printers | A | 44,500 | 49,250 | 54,000 |
| Solvent used per day (gal) | B | 0.7 | 18.4 | 36 |
| Days per year | C | 260 | 260 | 260 |
| Percent of products using methylene chloride1 | D | 0.01 | 0.01 | 0.01 |
| methylene chloride concentration (%w/w) | E | 45% | 45% | 45% |
| methylene chloride density (lb/gal) | F | 11.07 | 11.07 | 11.07 |
| **methylene chloride use (lb)** | **A x B x C x D x E x F** | **403,003** | **11,692,112** | **25,150,517** |
| *Source*: [Sutton, Wolf et al. (2009)](#_ENREF_65)  1 EPA assumption | | | | |

### Summary of Consumption Volumes by Use Category

Table 6‑9 summarizes the estimated consumption volumes for each use category, as well as the percentage of the approximately 263 million lbs of methylene chloride production from the 2016 CDR attributed to each use.

| Table 6‑9: Summary of Methylene Chloride Consumption Volume Estimates, by Use Category | | | |
| --- | --- | --- | --- |
| Use Category | Total Volume (lbs) | Percent of 2016 CDR Volume1 | Source |
| Cellulose Triacetate Film Production | 3,952 | 0.0% | Table 6‑2 |
| Vapor Degreasing | 327,126 | 0.1% | Table 6‑2 |
| Liquid Cleaners and Degreasers | 4,422,558 | 1.7% | Table 6‑2  Table 6‑7 |
| Aerosol Spray Cleaning/Degreasing | 1,556,186 | 0.6% | Table 6‑7 |
| Paint and Coating Removers | 54,877,568 | 20.8% | Table 6‑7 |
| Adhesive and Caulk Remover | 51,466 | 0.0% | Table 6‑7 |
| Lithographic Printing Cleaner | 11,692,112 | 4.4% | Table 6‑8 |
| Dry Cleaning and Spot Removers | 85,498 | 0.0% | Table 6‑7 |
| Paint and Coatings | 4,912,737 | 1.9% | Table 6‑7 |
| Glues, Sealants, Adhesives, and Caulks | 4,349,104 | 1.6% | Table 6‑7 |
| Lubricants and Greases | 2,037,131 | 0.8% | Table 6‑7 |
| Cold Pipe Insulation | 234,317 | 0.1% | Table 6‑7 |
| Anti-spatter Welding Aerosol | 27,054 | 0.0% | Table 6‑7 |
| **Total** | **84,576,809** | **32.0%** |  |
| 1 The risk evaluation reports 263,971,494 lbs of methylene chloride produced in the 2015 CDR reporting year ([EPA 2020i](#_ENREF_104)) | | | |

## Baseline Number of Firms and Occupational and Consumer Users, by Use Category

This section presents estimates for the number of annual occupational users, occupational non-users (ONUs), and consumer users estimated for each use category. Section 6.2.1 presents estimates for the number of occupational users and ONUs, Section 6.2.2 presents estimates for the number of consumer users, and Section 6.2.3 summarizes the total number of users across all use categories.

### Use Categories with Occupational Users

This section presents estimates for the number of occupational users and ONUs. Note that occupational users and occupational non-users are described in the rule as “potentially exposed persons.” Due to differing data availability, the number of users are estimated separately for aerosol spray degreasers, lithographic printing cleaners, use categories that are solely point sources, and use categories that are both point and nonpoint sources. For all use categories, the percentage of employees perform that are potentially exposed to methylene chloride is estimated using OSHA enforcement data. These approaches and estimates are described in further detail in the sections below.

#### Estimated Percentage of Employees per Firm Exposed to Methylene Chloride

EPA uses OSHA enforcement data to estimate the percentage of employees per establishment with potential exposure to methylene chloride. The data are updated daily and report 40 years of data on the approximately 100,000 inspections conducted annually. EPA utilizes two datasets to make this calculation:

1. *Inspection dataset*. The inspection dataset records information on each establishment where OSHA performed an inspection ([OSHA 2020a](#_ENREF_51)). OSHA may conduct inspections in response to imminent danger situations, severe injuries and illnesses, worker complaints, referrals, targeted inspections, or follow-up inspections ([OSHA 2016c](#_ENREF_50)). EPA relies on the following variables from the inspection dataset:

* Inspection ID
* 4-digit NAICS
* Number of employees in establishment

1. *Violation dataset*. The violation dataset records information on each establishment where OSHA issued a citation due to a standard violation ([OSHA 2020b](#_ENREF_52)). OSHA issues a citation to an establishment if there is a standard violation and if an employee has current, past, or potential exposure to the hazard in the previous six months ([OSHA 2016a](#_ENREF_48)). EPA relies on the following variables from the violation dataset:

* Inspection ID
* Standard
* Number of employees exposed
* Citation issuance date

EPA restricts the data to establishments in violation of one of the following standards, which direct employers to conduct exposure monitoring and medical surveillance for employees exposed to methylene chloride above OSHA’s action level. EPA uses the subset of establishments in violation of these standards as a proxy for the establishments with methylene chloride exposures. Use of these datasets requires the assumption that establishments that OSHA finds in violation of the exposure monitoring and medical surveillance standards are representative of all establishments that use methylene chloride.

1. *29 CFR 1910.1052(d)(2)* – Initial determination. Each employer whose employees are exposed to MC shall perform initial exposure monitoring to determine each affected employee’s exposure.
2. *29 CFR 1910.1052(d)(3)* – Where the initial determination shows employee exposures at or above the action level or above the STEL, the employer shall establish an exposure monitoring program for periodic monitoring of employee exposure to MC.
3. *29 CFR 1910.1052(j)(1)* – Affected employees. The employer shall make medical surveillance available for employees who are or may be exposed to MC.
4. *29 CFR 1910.1052(j)(2)* – Costs. The employer shall provide all required medical surveillance at no cost to affected employees, without loss of pay and at a reasonable time and place.

Some establishments were cited for more than one of the above standards. To avoid double-counting these establishments, EPA kept only the citation entry with the highest number of workers potentially exposed. EPA also restricts the data to citations issued within the last ten years (2010-2020).

For each NAICS, EPA estimates the percentage of workers exposed to methylene chloride by dividing the number of employees with methylene chloride exposures by the total number of employees for each establishment. EPA then estimates the average percentage of workers exposed per establishment across the affected NAICS for each use category (see Chapter 3 to see which NAICS are included for each use category).

| Table 6‑10: Percentage of Workers per Firm Exposed to Methylene Chloride | |
| --- | --- |
| Use Category | Percent of Employees Exposed to Methylene Chloride |
| Vapor Degreasing | 16% |
| Liquid Cleaners and Degreasers | 17% |
| Aerosol Spray Cleaning/Degreasing | 23% |
| Dry Cleaning and Spot Removers | 39% |
| Glues, Sealants, Adhesives, and Caulks | 21% |
| Adhesive and Caulk Remover | 21% |
| Lubricants and Greases | 36% |
| Cold Pipe Insulation | 45% |
| Paint and Coatings | 17% |
| Paint and Coating Removers - Graffiti Removal | 25% |
| Paint and Coating Removers - Bathtub Refinishing | 30% |
| Paint and Coating Removers - Automotive Repair and Refinishing | 18% |
| Furniture Refinishing | 29% |
| Paint and Coating Removers - Art Restoration | 27% |
| Aerospace Paint and Coating Removers | 43% |
| Paint and Coating Removers - Pleasure Craft Building and Repairing | 22% |
| Paint and Coating Removers - Professional Contracting | 31% |
| Anti-spatter Welding Aerosol | 35% |
| Lithographic Printing Cleaner | 18% |
| Recycling and disposal | 29% |
| Sources: [OSHA 2020a](#_ENREF_51), [OSHA 2020b](#_ENREF_52), [OSHA 2016a](#_ENREF_48), and [OSHA 2016c](#_ENREF_50) | |

#### Point Sources

For use categories expected to primarily consist of point sources, EPA estimates the total number of occupational users and ONUs exposed to methylene chloride as the product of the following:

* *Total number of firms*. EPA estimated the number of affected firms using EPA’s 2020 chemical data reporting (CDR) data ([EPA 2022a](#_ENREF_107)), firms reporting methylene chloride emissions to the 2017 NEI ([EPA 2020a](#_ENREF_96)), information provided during the Small Business Advocacy Review (SBAR) Panel, and firms identified by EPA as producing products containing methylene chloride (see notes in Table 6‑11)
* *Average number of employees exposed per firm*. For most use categories EPA estimated the number of workers exposed per firm using EPA’s chemical data reporting (CDR) data ([EPA 2022a](#_ENREF_107)). Manufacturers and importers of methylene chloride report the numbers of workers potentially exposed to the chemical in the CDR data. They also estimate the number of industrial sites and other industrial workers at those sites that may be exposed to the chemical. For vapor degreasing, EPA used data from the U.S. Census 2017 Statistics of U.S. Businesses (SUSB) on number of firms and total employment to estimate the average number of total employees per firm ([U.S. Census Bureau 2020](#_ENREF_78)). As shown above in Table 6‑10, 16% of employees of firms performing vapor degreasing are estimated to be potentially exposed.
* *Percentage of employees that are occupational users or ONUs.* EPA primarily uses estimates from the Final Risk Evaluation for Methylene Chloride Supplemental Information on Releases and Occupational Exposure Assessment ([EPA 2020i](#_ENREF_104)) on the estimated percentage of ONUs per site for each use category. As EPA ([2020i](#_ENREF_104)) does not provide these estimates for all use categories, this analysis assumes that the percentage of employees that are ONUs for cellulose triacetate film production is the same percentage as the risk evaluation’s estimate for plastic and rubber manufacturing. Second, the percentage of employees that are ONUs for vapor degreasing is assumed to be the same as the number of vapor degreasing employees exposed to TCE ([EPA 2020e](#_ENREF_100)).

Table 6‑11 presents the estimated number of occupational users and ONUs exposed to methylene chloride for point source use categories.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 6‑11: Estimated Number of Firms and Occupational Users - Point Sources | | | | | |
| Use Categories | Total Number of Firms | Average Number of Total Employees per Firm | Percentage of Employees that are ONUs | Estimated Number of Occupational Users Exposed | Estimated Number of ONUs Exposed |
| A | B | C | D = A × B × (1-C) | E = A × B × C |
| Manufacturing1 | 6 | 124 | 28% | **533** | **211** |
| Import/Repackage1 | 26 | 32 | 28% | **587** | **232** |
| Processing as a Reactant1 | 35 | 28 | 28% | **703** | **277** |
| Incorporation Into Formulation, Mixture, or Reaction Product 2 | 54 | 8 | 28% | **310** | **122** |
| Laboratory Use1 | 56 | 3 | 0% | **183** | **-** |
| Processing Aid, Plastics Manufacturing, and Solvent Welding1 | 44 | 8 | 0% | **352** | **-** |
| Cellulose Triacetate Film Production1 | 1 | 8 | 30% | **5** | **2** |
| Vapor Degreasing3 | 17 | 7 | 38% | **71** | **42** |
| Paint and Coatings4 | 123 | 8 | 16% | **799** | **151** |
| 1Number of firms and exposed workers estimated using EPA’s 2020 CDR data.  2Number of firms estimated as the number of firms identified as producing products containing methylene chloride. The number of exposed workers is estimated as the average number of exposed industrial workers according to EPA’s 2020 CDR data.  3Number of firms estimated using 2017 NEI data. EPA uses data from the U.S. Census 2017 Statistics of U.S. Businesses (SUSB) on number of firms and total employment to estimate the average number of total employees per firm ([U.S. Census Bureau 2020](#_ENREF_78)). Using OSHA data, EPA estimated that 16% of employees are potentially exposed to methylene chloride for vapor degreasing.  4Number of firms estimated using 2017 NEI data. EPA uses data from the U.S. Census 2017 Statistics of U.S. Businesses (SUSB) on number of firms and total employment to estimate the average number of total employees per firm ([U.S. Census Bureau 2020](#_ENREF_78)). Using OSHA data, EPA estimated that 17% of employees are potentially exposed to methylene chloride for paint and coatings.  Sources: [U.S. Census Bureau 2020](#_ENREF_78); [EPA 2020a](#_ENREF_96); [EPA 2020e](#_ENREF_100); [EPA 2020i](#_ENREF_104); [OSHA 2020a](#_ENREF_51); [OSHA 2020b](#_ENREF_52) | | | | | |

#### Point and Non-Point Sources

For use categories expected to consist of both point and non-point sources, the number of potentially exposed occupational users and ONUs are estimated as the product of the following:

* *Total number of firms.* EPA uses data from the U.S. Census 2017 SUSB on number of firms ([U.S. Census Bureau 2020](#_ENREF_78)). Estimates are averaged across the set of NAICS expected to be affected for each use category.
* *Percentage of firms using methylene chloride.* The percentage of total firms in the industry that use methylene chloride is assumed to be 10 percent for all uses except dry cleaning and spot removers (5%; best professional judgement) and cold cleaning (4%; [Wolf and Chesnutt 1987](#_ENREF_116)). Note that this percentage is not estimated for paint and coating remover uses, as the number of firms using methylene chloride is derived directly from EPA ([2019](#_ENREF_95)).
* *Average number of total employees per firm.* EPA uses data from the U.S. Census 2017 SUSB on number of firms and total employment to estimate the average number of total employees per firm ([U.S. Census Bureau 2020](#_ENREF_78)). Estimates are averaged across the set of NAICS expected to be affected for each use category.
* *Estimated percentage of total employees exposed to methylene chloride per firm*. See estimates in Table 6‑10.
* *Percentage of employees that are occupational users or ONUs.* EPA primarily uses estimates from the Final Risk Evaluation for Methylene Chloride Supplemental Information on Releases and Occupational Exposure Assessment ([EPA 2020i](#_ENREF_104)) for the estimated percentage of ONUs per site for each use category. As EPA ([2020i](#_ENREF_104)) does not provide these estimates for all use categories, this analysis assumes that the percentages of employees that are ONUs for cold pipe insulation and anti-spatter welding aerosol uses are the same as that for aerosol degreasers. In addition, the percentages for cold cleaning and paint and coating remover uses are assumed to be the same as the percentages for vapor degreasing and adhesive remover uses, respectively.

Table 6‑12presents the estimated number of occupational users and ONUs exposed to methylene chloride for point and non-point use categories.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 6‑12: Estimated Number of Occupational Users - Point and Non-Point Sources | | | | | | | | |
| Use Category | Total Number of Firms | Percentage of Firms Using methylene chloride | Estimated Number of Firms Using methylene chloride | Average Number of Total Employees per Firm | Estimated Percentage of Total Employees Exposed per Firm | Percentage of Employees that are ONUs | Estimated Number of Occupational Users Exposed | Estimated Number of ONUs Exposed |
| A | B | C = A x B | D | E | F | G = C x D x E x (1-F) | H = C x D x E x F |
| Liquid Cleaners and Degreasers | 179,751 | 4% | 7,190 | 42 | 17% | 71% | **14,900** | **35,760** |
| Paint and Coating Removers - Graffiti Removal | 2,145 | - | 105 | 131 | 25% | 9% | **3,144** | **298** |
| Paint and Coating Removers - Bathtub Refinishing | 206,582 | - | 436 | 6 | 30% | 9% | **725** | **69** |
| Paint and Coating Removers - Automotive Repair and Refinishing | 208,129 | - | 5,891 | 13 | 18% | 9% | **12,619** | **1,195** |
| Furniture Refinishing | 607,851 | - | 4,899 | 9 | 29% | 9% | **11,625** | **1,101** |
| Paint and Coating Removers - Art Restoration | 89,706 | - | 38 | 6 | 27% | 9% | **60** | **6** |
| Aerospace Paint and Coating Removers | 38,656 | - | 272 | 7 | 43% | 9% | **762** | **72** |
| Paint and Coating Removers - Pleasure Craft Building and Repairing | 29,580 | - | 1,279 | 15 | 22% | 9% | **3,665** | **347** |
| Paint and Coating Removers - Professional Contracting | 735,103 | - | 622 | 9 | 31% | 9% | **1,536** | **145** |
| Anti-spatter Welding Aerosol | 59,915 | 10% | 5,992 | 8 | 35% | 10% | **14,820** | **1,719** |
| Adhesive and Caulk Remover | 39,855 | 10% | 3,986 | 63 | 21% | 9% | **48,523** | **4,597** |
| Dry Cleaning and Spot Removers | 27,812 | 5% | 1,391 | 6 | 39% | 16% | **2,792** | **527** |
| Glues, Sealants, Adhesives, and Caulks | 39,855 | 10% | 3,986 | 63 | 21% | 23% | **40,862** | **12,259** |
| Lubricants and Greases | 194,499 | 10% | 19,450 | 7 | 36% | 10% | **46,967** | **5,448** |
| Cold Pipe Insulation | 106,949 | 10% | 10,695 | 11 | 45% | 10% | **46,521** | **5,396** |
| Sources: [U.S. Census Bureau 2020](#_ENREF_78); [EPA 2019](#_ENREF_95); [EPA 2020i](#_ENREF_104); [OSHA 2020a](#_ENREF_51); [OSHA 2020b](#_ENREF_52); [Wolf and Chesnutt 1987](#_ENREF_116) | | | | | | | | |

#### Aerosol Spray Degreasers

In section 6.1, EPA presented estimates for the volumes of methylene chloride used, by use category. These estimates for aerosol cleaning and degreasing are summarized below in Table 6‑13. The pounds of methylene chloride per can are estimated assuming each can is 19 ounces and is combined with the total volume consumed to estimate the total number of cans consumed. Based on a California Air Resource Board (CARB) survey of manufacturers of brake cleaning products ([CARB 2000](#_ENREF_8)), 10% of consumption of aerosol cleaners/degreasers is assumed to be by consumers. The remaining 90% of products are assumed to be consumed by commercial and industrial users, as shown in Table 6‑13.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 6‑13: Estimated Number of Aerosol Spray Cleaning/Degreasing Cans Used Annually by Occupational Users | | | | | |
| Use Category | Annual Volume of Methylene Chloride Consumed (lbs) | Concentration | Estimated oz of Methylene Chloride Per 19 oz Can | Estimated Annual Cans of Product Consumed | Estimated Number of 19oz Cans Used Annually by Commercial and Industrial Users |
| A | B | C = 19 x B | D = A / (C ÷ 16 oz/lb) | E = 90% x D |
| Aerosol Spray Cleaning/Degreasing (Brake Cleaner) | 203,675 | 65% | 12.35 | 263,871 | 237,484 |
| Aerosol Spray Cleaning/Degreasing (Carburetor or Fuel-Injection Air Intake Cleaner; Carbon Remover) | 80,990 | 45% | 8.55 | 151,561 | 136,405 |
| Aerosol Spray Cleaning/Degreasing (Other – Electronic Cleaner and A/C Coil Cleaner) | 1,271,520 | 75% | 14.25 | 1,427,672 | 1,284,905 |
| **All Aerosol Cleaning/Degreasing** | **1,556,186** | **72%** | **0.05** | **1,843,104** | **1,658,794** |

Table 6‑14 presents the estimated number of establishments using methylene chloride aerosol cleaners/degreasers and the number of workers and ONUs exposed to methylene chloride from using methylene chloride aerosol cleaners/degreasers. The number of establishments using methylene chloride aerosol brake cleaners is estimated from the number of cans shown in Table 6‑13 and assuming that the average facility performs 936 brake jobs per year and uses 14.4 ounces of brake cleaning product per job ([CARB 2000](#_ENREF_8)). Assuming each can is 19 ounces, this equates to approximately 0.756 cans per job. Since per facility usage estimates were only available for brake cleaners, EPA assumes that the level of usage is similar for the other auto parts aerosols. However, since coil cleaners and oven and grill cleaners are not expected to be used as often, EPA assumed ten uses annually by each firm.

EPA then multiplies the estimated number of firms by the average number of workers per firm, the estimated percentage of workers exposed to methylene chloride per firm, and the percentage of employees that are occupational users or ONUs, as described in previous sections for other use categories.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 6‑14: Estimated Number of Occupational Users - Aerosol Spray Degreasers | | | | | | | | |
| Use Category | Estimated Number of 19oz Cans Used Annually by Commercial and Industrial Users | Estimated Number of Jobs per Firm | Estimated Number of Firms using Methylene Chloride Products | Average Number of Total Workers per Firm | Estimated Percentage of Workers Exposed per Firm | Percentage of Employees that are ONUs | Estimated Number of Workers Exposed | Estimated Number of ONUs Exposed |
| E | F | G = E / (F x 0.758 cans/job) | H | I | J | K = G x H x I x (1-J) | L = G x H x I x J |
| Aerosol Spray Cleaning/Degreasing (Brake Cleaner) | 237,484 | 936 | 334.77 | 14.78 | 23% | 10% | 1,030 | 114 |
| Aerosol Spray Cleaning/Degreasing (Carburetor or Fuel-Injection Air Intake Cleaner; Carbon Remover) | 136,405 | 936 | 192.28 | 14.78 | 23% | 10% | 591 | 66 |
| Aerosol Spray Cleaning/Degreasing (Other – Electronic Cleaner and A/C Coil Cleaner) | 1,284,905 | 10 | 169,536.04 | 14.78 | 23% | 10% | 521,481 | 57,942 |
| **All Aerosol Cleaning/Degreasing** | **1,658,794** | **-** | **170,063.10** | **14.78** | **23%** | **10%** | **523,102** | **58,122** |
| Sources: [U.S. Census Bureau 2020](#_ENREF_78); [CARB 2000](#_ENREF_8); [EPA 2020i](#_ENREF_104); [OSHA 2020a](#_ENREF_51); [OSHA 2020b](#_ENREF_52) | | | | | | | | |

#### Lithographic Printing Cleaner

[Sutton, Wolf et al. (2009)](#_ENREF_65) collected data from a sample of lithographic printing cleaners and report a range of 0.7 to 36 gallons of solvent used per firm per day, or an average of 18.35 gallons per day and 4,771 gallons per year. Assuming a density of 11.07 lb/gal methylene chloride, EPA estimates each firm will use an average of 52,815 lbs of methylene chloride per year (Table 6‑15; Column B). EPA divides the estimated volume of methylene chloride used in lithographic printing cleaners (derived in section 6.1) by the estimated average volume of methylene chloride used per firm to estimate the number of firms using lithographic printing cleaners with methylene chloride.

EPA then multiplies the estimated number of firms by the average number of workers per firm, the estimated percentage of workers exposed to methylene chloride per firm, and the percentage of employees that are occupational users or ONUs, as described in previous sections for other use categories.

Table 6‑15presents the estimated number of occupational users and ONUs exposed to methylene chloride in lithographic printing cleaners.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 6‑15: Estimated Number of Occupational Users - Lithographic Printing Cleaner | | | | | | | | |
| Use Category | Annual Volume of Methylene Chloride Consumed (lbs) | Average Annual Volume of Solvent per Firm (lbs) | Estimated Number of Firms | Average Number of Total Workers per Firm | Estimated Percentage of Workers Exposed per Firm | Percentage of Employees that are ONUs | Estimated Number of Occupational Users Exposed | Estimated Number of ONUs Exposed |
| A | B | C = A / B | D | E | F | G = C x D x E x (1-F) | H = C x D x E x F |
| Lithographic Printing Cleaner | 11,692,112 | 52,815 | 221 | 100 | 18% | 32% | **2,672** | **1,269** |
| Sources: [U.S. Census Bureau 2020](#_ENREF_78); [EPA 2020i](#_ENREF_104); [OSHA 2020a](#_ENREF_51); [OSHA 2020b](#_ENREF_52); [Sutton, Wolf et al. 2009](#_ENREF_65) | | | | | | | | |

### Use Categories with Consumer Users

This section presents estimates for the number of consumer users. Due to differing data availability, the number of users are estimated separately for aerosol spray degreasers and for other use categories. These approaches and estimates are described in further detail in the sections below.

#### Aerosol Spray Degreasers

The number of consumer users of aerosol spray cleaning/degreasing products is estimated using the same approach as the number of occupational users of aerosol spray cleaning/degreasing products. These estimates are presented below in Table 6‑16. As with the occupational users, each can is assumed to be 19 ounces and is combined with the total volume consumed to estimate the total number of cans consumed. Based on a California Air Resource Board (CARB) survey of manufacturers of brake cleaning products ([CARB 2000](#_ENREF_8)), 10% of consumption of aerosol cleaners/degreasers is assumed to be by consumers. The number of annual consumer users are estimated by assuming that each consumer uses one can annually.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 6‑16: Estimated Number of Consumer Users - Aerosol Spray Cleaning/Degreasing | | | | | |
| Use Category | Annual Volume of Methylene Chloride Consumed (lbs) | Methylene Chloride Concentration | Estimated Oz of Methylene Chloride Per 19 oz. Can | Estimated Annual Cans of Product Consumed | Estimated Number of Consumer Users |
| A | B | C | D = A / (C ÷ 16 oz/lb) | E = 10% x D |
| Aerosol Spray Cleaning/Degreasing (Brake Cleaner) | 203,675 | 65% | 12.35 | 263,871 | 26,387 |
| Aerosol Spray Cleaning/Degreasing (Carburetor or Fuel-Injection Air Intake Cleaner; Carbon Remover) | 80,990 | 45% | 8.55 | 151,561 | 15,156 |
| Aerosol Spray Cleaning/Degreasing (Other – Electronic Cleaner and A/C Coil Cleaner) | 1,271,520 | 75% | 14.25 | 1,427,672 | 142,767 |
| **All Aerosol Spray Cleaning/Degreasing** | **1,556,186** | **72%** | **0.05** | **1,843,104** | **184,310** |

#### Other Use Categories with Consumer Users

Table 6‑17 presents the estimated number of consumer users for the remaining use categories. EPA estimates the annual number of consumer users by dividing the total annual volume of consumer products containing methylene chloride by the expected annual volume of product used per consumer. The median annual volume of product used per consumer user is estimated from Table 17-6 in EPA’s 2011 Exposure Factors Handbook ([EPA 2011a](#_ENREF_83)). As shown in Table 6‑17, the total annual volume of products containing methylene chloride is derived using estimates for the volume of methylene chloride consumed for each use category (see section 6.1), the percentage of the total volume attributed to consumer users, and the concentration of methylene chloride in each consumer product. The concentration of methylene chloride in consumer products is estimated using the products identified in Chapter 3.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 6‑17: Estimated Annual Number of Consumer Users | | | | | | | | |
| Use Category | Annual Volume of Methylene Chloride Consumed (lbs) | Percentage Consumer Use | Estimated Volume of Consumer Methylene Chloride Use (oz) | Methylene Chloride Product Concentration | Estimated Volume of Consumer Product Use (oz) | Median Consumer Product Use (oz/year) | Number of Annual Consumer Users | Notes |
| A | B | C = A x B x 16 oz/lb | D | E = C / D | F | G = E / F |
| Adhesive and Caulk Remover | 51,466 | 10% | 82,346 | 50% | 164,691 | 10.88 | 15,137 | EPA ([2011a](#_ENREF_60)) product category: Adhesive Removers |
| Anti-spatter Welding Aerosol | 27,054 | 10% | 43,286 | 50% | 86,572 | 16 | 5,411 | EPA (2011a) product category: Solvent-type Cleaning Fluids or Degreasers |
| Cold Pipe Insulation | 234,317 | 10% | 374,908 | 45.00% | 833,128 | 6 | 138,855 | EPA (2011a) product category: Solvent-type Cleaning Fluids or Degreasers |
| Glues, Sealants, Adhesives, and Caulks | 4,349,104 | 10% | 6,958,566 | 50.00% | 13,917,131 | 1 | 13,917,131 | EPA (2011a) product category: Carburetor Cleaners |
| Lubricants and Greases | 2,037,131 | 10% | 3,259,410 | 50% | 6,518,820 | 6 | 1,086,470 | EPA (2011a) product category: Water Repellents/Protectors |
| Sources: [EPA 2011a](#_ENREF_83); Table 6‑9 | | | | | | | | |

### Summary of Firms and Occupational and Consumer Users

Table 6‑18 presents a summary of the number of facilities using methylene chloride and the number of occupational and consumer users exposed to methylene chloride for each use category.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 6‑18: Summary of Occupational and Consumer Users | | | | |
| Use Category | Number of Facilities | Number of Workers | Number of ONUs | Number of Consumers |
| Manufacturing | 6 | 533 | 211 | - |
| Import/Repackage | 26 | 587 | 232 | - |
| Processing as a reactant | 35 | 703 | 277 | - |
| Incorporation Into Formulation, Mixture, or Reaction Product | 54 | 310 | 122 | - |
| Waste Handling, Disposal, Treatment, and Recycling | 1,091 | 7,493 | 4,746 | - |
| Laboratory Use | 56 | 183 | 0 | - |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | 44 | 352 | 0 | - |
| Aerospace Paint and Coating Removers | 272 | 762 | 72 |  |
| Cellulose Triacetate Film Production | 1 | 5 | 2 | - |
| Furniture Refinishing | 4,899 | 11,625 | 1,101 |  |
| Vapor Degreasing | 17 | 71 | 42 | - |
| Liquid Cleaners and Degreasers | 7,190 | 14,900 | 35,760 | - |
| Aerosol Spray Cleaning/Degreasing | 170,063 | 523,102 | 58,122 | 184,310 |
| Paint and Coating Removers (except aerospace and furniture refinishing) | 8,371 | 21,749 | 2,060 | - |
| Adhesive and Caulk Remover | 3,986 | 48,523 | 4,597 | 15,137 |
| Lithographic Printing Cleaner | 221 | 2,672 | 1,269 | - |
| Dry Cleaning and Spot Removers | 1,391 | 2,792 | 527 | - |
| Paint and Coatings | 123 | 799 | 151 | - |
| Glues, Sealants, Adhesives, and Caulks | 3,986 | 40,862 | 12,259 | 13,917,131 |
| Lubricants and Greases | 19,450 | 46,967 | 5,448 | 1,086,470 |
| Cold Pipe Insulation | 10,695 | 46,521 | 5,396 | 138,855 |
| Anti-spatter Welding Aerosol | 5,992 | 14,820 | 1,719 | 5,411 |
| **Total** | **237,969** | **786,331** | **134,113** | **15,347,314** |

# Cost Analysis

This chapter presents the estimated incremental costs of the options considered in this analysis across the regulated use categories. Unless otherwise noted, costs are presented in 2022$ in this document. Section 7.1 summarizes the options considered for each use category. Section 7.2 addresses the timeframe of the analysis with respect to annualized costs. Section 7.3 presents a summary of the number of affected entities with incremental costs. Section 7.4 presents the fully loaded wage rates used in the economic analysis. Section 7.5 presents estimated costs for downstream notification. Section 7.5 presents estimated costs for the reformulation of products containing methylene chloride. Section 7.7 presents estimated costs for switching to alternatives to methylene chloride in vapor degreasing. Section 7.9 presents estimated costs for the workplace chemical protection program (WCPP) dermal protection requirements. Section 7.10 presents estimated costs for compliance with the exposure monitoring and respiratory protection component of the WCPP for methylene chloride. Section 7.11 summarizes the combined costs for WCPP requirement compliance. Section 7.12 presents the estimated costs for use of APF 50 respirator protection for furniture refinishing. Section 7.13 presents a discussion of unquantified costs and other uncertainties underlying the cost estimates. Section 7.14 presents total annualized costs.

Figure 7‑1, on the following page, presents an overview of the key elements of the cost analysis.

|  |
| --- |
| Figure 7‑1: Overview of Key Quantified Elements of the Cost Analysis |
|  |

## Description of options

To address the unreasonable risk EPA has identified, EPA’s final rule will: prohibit the manufacture, processing, and distribution in commerce of methylene chloride for consumer use; prohibit most industrial and commercial uses of methylene chloride; require a workplace chemical protection program (WCPP) for certain conditions of use of methylene chloride, which would include inhalation exposure concentration limits; require recordkeeping and downstream notification requirements for several conditions of use of methylene chloride; and provide a time-limited exemption as appropriate under TSCA section 6(g). Cost impacts of 6(g) exemptions or special considerations for certain uses by other federal agencies or their contractors are not included in the qualitative cost analysis due to insufficient data. Table 7‑1 summarizes the options analyzed by use category.

| Table 7‑1: Summary of Options Analyzed by Use Category | | | |
| --- | --- | --- | --- |
| Use Category | Condition of Use (COU) | Option 1 | Option 2 |
| Manufacturing | Manufacturing (Domestic manufacturing) | WCPP | WCPP |
| Import/Repackage | Manufacturing (Import) |
| Processing: repackaging |
| Processing as a Reactant | Processing: processing as a reactant |
| Incorporation Into Formulation, Mixture, or Reaction Product | Processing: incorporation into a formulation, mixture, or reaction product |
| Industrial and commercial use as solvent that becomes part of a formulation or mixture |
| Waste Handling, Disposal, Treatment, and Recycling | Processing: recycling |
| Disposal |
| Laboratory Use | Industrial and commercial use as a laboratory chemical |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Industrial and commercial use as a processing aid | Prohibit |
| Industrial and commercial use as a solvent that becomes part of a formulation or mixture, where that formulation or mixture will be used inside a manufacturing process, and the solvent (methylene chloride) will be reclaimed |
| Industrial and commercial use for plastic and rubber products manufacturing |
| Industrial or commercial use as a bonding agent for solvent welding |
| Aerospace Paint and Coating Removers | Industrial and commercial use as a paint and coating remover from safety critical, corrosion-sensitive components of aircraft and spacecraft | Prohibit with a 10-year time-limited exemption and interim WCPP |
| Cellulose Triacetate Film Production | Industrial and commercial use in cellulose triacetate film production | Prohibit | WCPP |
| Furniture Refinishing | Industrial and commercial use in paint and coating removal in furniture refinishing for intricate or historically significant wood pieces | Prohibit after 5 years with interim worker protection requirements | Prohibit |
| Glues, Sealants, Adhesives, and Caulks | Industrial and commercial use in adhesives and sealants in aircraft, space vehicle, and turbine applications for structural and safety critical non-structural applications | Prohibit after 5 years | Prohibit |
| Industrial and commercial use in adhesives, sealants and caulks (except adhesives and sealants in aircraft, space vehicle, and turbine applications for structural and safety critical non-structural applications) | Prohibit | Prohibit |
| Consumer use in adhesives and sealants |
| Consumer use in arts, crafts, and hobby materials glue |
| Vapor Degreasing | Industrial and commercial use as solvent for batch vapor degreasing |
| Industrial and commercial use as solvent for in-line vapor degreasing |
| Liquid Cleaners and Degreasers | Industrial and commercial use as solvent for cold cleaning |
| Industrial and commercial use in metal non-aerosol degreasers |
| Industrial and commercial use in non-aerosol degreasers and cleaners |
| Aerosol Spray Cleaning/Degreasing | Industrial and commercial use as a solvent for aerosol spray degreaser/cleaner |
| Industrial and commercial use in metal aerosol degreasers |
| Industrial and commercial use in automotive care products (interior car care) |
| Industrial and commercial use in automotive care products (degreasers) |
| Industrial and commercial use in aerosol degreasers and cleaners |
| Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner1 |
| Consumer use as solvent in aerosol degreasers/cleaners |
| Consumer use in metal degreasers |
| Consumer use in automotive care products (degreasers) |
| Consumer use in carbon removers and other brush cleaners1 |
| Paint and Coating Removers (except aerospace and furniture refinishing) | Industrial and commercial use in paint and coating removers (except select wood furniture and safety critical, corrosion-sensitive components of aircraft and spacecraft) |
| Adhesive and Caulk Remover | Industrial and commercial use in adhesive and caulk removers |
| Consumer use in adhesive and caulk removers |
| Lithographic Printing Cleaner | Industrial and commercial use in lithographic printing plate cleaner |
| Dry Cleaning and Spot Removers | Industrial and commercial use in spot removers for apparel and textiles |
| Paint and Coatings | Industrial and commercial use in paints and coatings |
| Lubricants and Greases | Industrial and commercial use in liquid lubricants and greases |
| Industrial and commercial use in spray lubricants and greases |
| Consumer use in lubricants and greases |
| Cold Pipe Insulation | Industrial and commercial use in cold pipe insulations |
| Consumer use in cold pipe insulation |
| Anti-spatter Welding Aerosol | Industrial and commercial use as anti-spatter welding aerosol |
| Consumer use in an anti-spatter welding aerosol |
| Toys, Playground, and Supporting Equipment | Industrial and commercial use in toys, playground and sporting equipment |
| Uses believed to be inactive or fully overlap with other conditions of use | |  |  |
| Wood Floor and Brush Cleaners | Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner1 | Prohibit | Prohibit |
| Consumer use in carbon removers and other brush cleaners1 |
| Consumer use in brush cleaners for paints and coatings2 |
| Functional Fluids | Industrial and commercial use in automotive care products (functional fluids for air conditioners2 |
| Consumer use in automotive care products (functional fluids for air conditioners)2 |
| Propellant and Blowing Agent | Industrial and commercial use as a propellant and blowing agent3 |
| Finishing Products for Fabric, Textiles and Leather | Industrial and commercial use in finishing products for fabric, textiles and leather4 |
| Industrial and commercial use in apparel and footwear care products4 |
| Electrical Equipment, Appliance, and Component Manufacturing | Industrial and commercial use for electrical equipment, appliance, and component manufacturing4 |
| Oil and Gas Drilling | Industrial and commercial use for oil and gas drilling, extraction, and support activities4 |
| 1EPA believes that brush cleaning is an inactive use. Wood floor cleaning is also believed to be an inactive use (although paint removers may be used for this purpose). Carbon removers are an active use and included under aerosol spray cleaning/degreasing. Note that these COUs are listed twice since they include both active and inactive uses.  2Based on market research, EPA believes these are inactive uses.  3Based on stakeholder outreach with industry, EPA believes this is an inactive use.  4These COUs are defined according to the sector using methylene chloride. EPA believes that there are no active uses in these sectors or that the uses by these sectors overlap with one or more of the COUs that are defined according to how the methylene chloride is being used.  Note: Use of methylene chloride by Federal agencies and contractors acting on or behalf of Federal agencies are subject to a different compliance timeframe not captured in our analyses. | | | |

## Timeline for the analysis

In selecting the number of years of the policy to consider in the cost-benefit analysis, it is important to select a timeframe sufficiently long enough to capture the important effects of the benefits and the costs without selecting a timeframe that is so long that it adds unnecessary uncertainty. In addition, EPA’s ([2014a](#_ENREF_86)) *Guidelines for Preparing Economic Analyses* suggests the following when selecting the time horizon:

While there is little theoretical guidance on the time horizon of economic analyses, a guiding principle is that the time span should be sufficient to capture major welfare effects from policy alternatives. … That is, the time horizon should be long enough that the net benefits for all future years (beyond the time horizon) are expected to be negligible when discounted to the present. In practice, however, it is not always obvious when this will occur because it may be unclear whether or when the policy will be renewed or retired by policy makers, whether or when the policy will become obsolete or “non-binding” due to exogenous technological changes, how long the capital investments or displacements caused by the policy will persist, etc.

As a practical matter, reasonable alternatives for the time span of the analysis may be based on assumptions regarding:

* The expected life of capital investments required by or expected from the policy;
* The point at which benefits and costs reach a steady state;
* Statutory or other requirements for the policy or the analysis; and/or
* The extent to which benefits and costs are separated by generations.

The recommendation in EPA’s ([2014a](#_ENREF_86)) guidance that “the time horizon should be long enough that the net benefits for all future years (beyond the time horizon) are expected to be negligible when discounted to the present” would imply that a fairly long time horizon would be appropriate. For example, if it is assumed that the regulation never becomes obsolete or non-binding, net benefits in the 100th year of the policy would still exceed $100,000 after discounting them back to present dollars using a 3% discount rate. However, the probability that the rule becomes obsolete increases over time. For example, newer chemicals could make methylene chloride obsolete without any rule. Given this uncertainty, EPA selected a shorter time horizon of 20 years for the analysis. A time period of 20 years is short enough that the products that were reformulated to be methylene chloride-free would probably not need to be reformulated again during that time period. In addition, the relative rankings of the net benefits under the regulatory options would remain unchanged under any time horizon. Nevertheless, given the uncertainties about the extent to which methylene chloride would be used in the absence of EPA action more than 20 years in the future, EPA believes that the 20-year analytical timeframe is appropriate.

The present discounted value for the annualized 20 year stream of costs is estimated using discount rates of 3 and 7 percent. Costs are discounted (for the discount rate r = 3% and r = 7%) back to the beginning of the 20-year period, as follows:

|  |  |
| --- | --- |
|  | (1) |

The present discounted value costs are annualized as follows:

|  |  |
| --- | --- |
|  | (2) |

## Summary of Number of Affected Entities

Table 7‑2 presents the estimated numbers of sites, workers, and occupational non-users (ONUs). Descriptions of how these estimates were derived are presented in section 6.2.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 7‑2: Number of Sites, Workers, and ONUs Affected by Methylene Chloride Risk Management | | | |
| Use Category | Number of Firms | Number of Workers | Number of ONUs |
| Manufacturing | 6 | 533 | 211 |
| Import/Repackage | 26 | 587 | 232 |
| Processing as a reactant | 35 | 703 | 277 |
| Incorporation Into Formulation, Mixture, or Reaction Product | 54 | 310 | 122 |
| Waste Handling, Disposal, Treatment, and Recycling | 1,091 | 7,493 | 4,746 |
| Laboratory Use | 56 | 183 | 0 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | 44 | 352 | 0 |
| Aerospace Paint and Coating Removers | 272 | 762 | 72 |
| Cellulose Triacetate Film Production | 1 | 5 | 2 |
| Furniture Refinishing | 4,899 | 11,625 | 1,101 |
| Glues, Sealants, Adhesives, and Caulks | 3,986 | 40,862 | 12,259 |
| Vapor Degreasing | 17 | 71 | 42 |
| Liquid Cleaners and Degreasers | 7,190 | 14,900 | 35,760 |
| Aerosol Spray Cleaning/Degreasing | 170,063 | 523,102 | 58,122 |
| Paint and Coating Removers (Graffiti Removal) | 105 | 3,144 | 298 |
| Paint and Coating Removers (Bathtub Refinishing) | 436 | 725 | 69 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | 5,891 | 12,619 | 1,195 |
| Paint and Coating Removers (Art Restoration) | 38 | 60 | 6 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | 1,279 | 3,665 | 347 |
| Paint and Coating Removers (Professional Contracting) | 622 | 1,536 | 145 |
| Adhesive and Caulk Remover | 3,986 | 48,523 | 4,597 |
| Lithographic Printing Cleaner | 221 | 2,672 | 1,269 |
| Dry Cleaning and Spot Removers | 1,391 | 2,792 | 527 |
| Paint and Coatings | 123 | 799 | 151 |
| Lubricants and Greases | 19,450 | 46,967 | 5,448 |
| Cold Pipe Insulation | 10,695 | 46,521 | 5,396 |
| Anti-spatter Welding Aerosol | 5,992 | 14,820 | 1,719 |
| **Total** | **237,969** | **786,331** | **134,113** |

## Industry Wage Rates

Wage and fringe benefit data for each labor category (*e.g.*, managerial, professional/technical, clerical) are taken from the U.S. Bureau of Labor Statistics (BLS) Employer Costs for Employee Compensation (ECEC) Supplementary Tables ([BLS 2022](#_ENREF_73)). In the BLS report, wages are represented by the “wages and salaries” cost component and fringe benefits are represented by “total benefits.”

Overhead costs are assumed to equal 20% of the sum of wages plus fringe benefits. This loading factor is described in *Handbook on Valuing Changes in Time Use Induced by Regulatory Requirements and Other U.S. EPA Actions* ([EPA 2020f](#_ENREF_101)), and is reflective of multiplier values used in prior EPA economic analyses and information collection requests (ICRs) that are based on industry- and occupation-specific overhead rates affected by EPA regulations. This overhead loading factor is multiplied by the total compensation (wages plus fringe benefits). For example, the December 2022 fully loaded wage for production labor is ($21.79 + $11.63) \* 1.2 = $40.10. Table 7‑5 presents the total hourly loaded wages used in this analysis.

| Table 7‑3: Industry Wage Rates (2022$) | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Labor Category | Data Series | Date | Wage ($/hour) | Fringe Benefit | Total Compen-sation | Overhead as % of Total Compen-sation1 | Overhead | Hourly Loaded Wages |
| (a) | (b) | (c) =(b)+(a) | (d) | (e)=(c)\*(d) | (f)=(c)+(e) |
| Manufacturing/ Production Worker | BLS ECEC, Private Manufacturing Industries, “Production occupations”2 | Dec-22 | $21.79 | $11.63 | $33.42 | 20% | $6.68 | $40.10 |
| Manufacturing/Managerial | BLS ECEC, Private Manufacturing industries, “Mgt, Business, and Financial”2 | Dec-22 | $54.29 | $24.66 | $78.95 | 20% | $15.79 | $94.74 |
| Construction and Mining/ Managerial | BLS *ECEC*, Private Goods Producing Industries*,* “Mgt, Business, and Financial”2 | Dec-22 | $52.17 | $22.53 | $74.70 | 20% | $14.94 | $89.64 |
| Construction and Mining/ Extraction Worker | BLS *ECEC*, Private Goods Producing Industries*,* “Construction, extraction, farming, fishing, and forestry” 2 | Dec-22 | $28.68 | $13.71 | $42.39 | 20% | $8.48 | $50.87 |
| Transportation and Public Utilities/  Managerial | BLS *ECEC*, Trade, Transportation, and Utilities Industries*,* “Mgt, Business, and Financial” 2 | Dec-22 | $54.12 | $21.82 | $75.94 | 20% | $15.19 | $91.13 |
| Transportation and Public Utilities/  Maintenance and Repair Worker | BLS *ECEC*, Trade, Transportation, and Utilities Industries*,* “Installation, maintenance, and repair"2 | Dec-22 | $31.08 | $15.29 | $46.37 | 20% | $9.27 | $55.64 |
| Services/  Managerial | BLS ECEC, Service-providing Industries, Management, professional, and related occupations, “Mgt, Business, and Financial” | Dec-22 | $54.77 | $24.99 | $79.76 | 20% | $15.95 | $95.71 |
| Services/  Maintenance and Repair Worker | BLS ECEC, Service-providing Industries, Natural resources, construction, and maintenance occupations, “Installation, maintenance, and repair" | Dec-22 | $28.39 | $13.15 | $41.54 | 20% | $8.31 | $49.85 |
| Certified Industrial Hygienist | Wage*: BLS OEWS Occupational Health & Safety Specialists (19-5011)* Fringes as percent of wage: BLS ECEC, Private Manufacturing industries, “Professional and related occupations” 3,4 | May-22 | $39.47 | $19.96 | $59.43 | 20% | $11.89 | $71.32 |
| Technical Specialist | Wage*: BLS OEWS Occupational Health & Safety Technicians (19-5012)* Fringes as percent of wage: BLS ECEC, Private Manufacturing industries, “Professional and related occupations” 3,4 | May-22 | $27.67 | $14.05 | $41.72 | 20% | $8.34 | $50.06 |
| Senior Engineer and Technical Advisor (vapor degreasing) | Wage*: BLS OEWS Plant and Systems Operators (51-8000)* Fringes as percent of wage: BLS ECEC, Manufacturing industry | May-22 | $33.85 | $17.12 | $50.97 | 20% | $10.19 | $61.16 |
| Vapor Degreasing Technician | Wage*: BLS OEWS Architectural and Engineering Managers (11-9041)* Fringes as percent of wage: BLS ECEC, Manufacturing industry | May-22 | $78.52 | $39.71 | $118.23 | 20% | $23.65 | $141.88 |
| 1 An overhead rate of 20 percent is used based on assumptions in *Handbook on Valuing Changes in Time Use Induced by Regulatory Requirements and Other U.S. EPA Actions* ([EPA 2020f](#_ENREF_101)).  2 Source: *Employer Costs for Employee Compensation Historical Supplementary Tables, National Compensation Survey: December 2022* ([BLS 2023b](#_ENREF_75)).  3 Source: *Occupational Employment Statistics* *(Occupational Employment and Wage Statistics*) for May 2022 ([BLS 2023c](#_ENREF_76)).  4 Fringe benefits are not reported in the BLS Occupational Employment and Wage Statistics (OEWS; [BLS 2023c](#_ENREF_76)). It is therefore is assumed that fringes as a percentage of wages are 50.77 percent, based on the percentage for Private Manufacturing Industries, “Professional and related” in the BLS ECEC ([BLS 2023b](#_ENREF_75)).  5 Fringe benefits are not reported in the BLS OEWS ([BLS 2023c](#_ENREF_76)). It is therefore is assumed that fringes as a percentage of wages are 44 percent, based on the percentage for Health Care and Social Assistance Industry, “Professional and related” in the BLS ECEC ([BLS 2023b](#_ENREF_75)). | | | | | | | | |

## Rule Familiarization and Downstream Notification Costs

Firms that are not subject to WCPP requirements are assumed to incur an initial managerial labor burden of one hour. Firms that are subject to WCPP requirements (or other interim worker protection requirements) are assumed to incur an initial industrial hygienist labor burden of three hours. The additional two hours of rule familiarization for firms subject to WCPP requirements are a result of the complexity of WCPP compliance when compared to firms subject to prohibition requirements.

The wage rates used for the Waste Handling, Disposal, Treatment, and Recycling use category are the transportation and public utilities sector wages ($91.13). The wage rate for the Furniture Refinishing, Paint and Coating Removers/Automotive Repair and Refinishing, Paint and Coating Removers/Art Restoration, Liquid Cleaners and Degreasers, Aerosol Spray Cleaning/Degreasing, Dry Cleaning and Spot Removers, and Lubricant and Greases use categories are the service sector wages ($95.71). The wage rate for the Paint and Coating Removers/Graffiti Removal, Paint and Coating Removers/Bathtub Refinishing Paint and Coating Removers/Professional Contracting, and Cold Pipe Insulation use categories is the construction sector wage ($89.64). The manufacturing sector wage was used for other use categories ($94.74).

Table 7‑4 presents the rule familiarization costs by use category under prohibition and/or WCPP or other worker protection requirements. For example, the prohibition rule familiarization cost is “n.a.” for manufacturers because they are subject to WCPP requirements under both options.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 7‑4: Total Rule Familiarization Costs (2022$) | | | |
| Use Category | Number of Sites | Initial Costs (Prohibition) | Initial Costs (WCPP or other worker protection requirements) |
| Manufacturing | 6 | n.a. | $1,284 |
| Import/Repackage | 26 | n.a. | $5,563 |
| Processing as a reactant | 35 | n.a. | $7,488 |
| Incorporation Into Formulation, Mixture, or Reaction Product | 54 | n.a. | $11,554 |
| Waste Handling, Disposal, Treatment, and Recycling | 1,091 | n.a. | $233,426 |
| Laboratory Use | 56 | n.a. | $11,982 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | 44 | $4,169 | $9,414 |
| Aerospace Paint and Coating Removers | 272 | n.a. | $58,196 |
| Cellulose Triacetate Film Production | 1 | $95 | $214 |
| Furniture Refinishing | 4,899 | $468,883 | $1,048,172 |
| Glues, Sealants, Adhesives, and Caulks | 3,986 | $377,634 | $852,830 |
| Vapor Degreasing | 17 | $1,611 | n.a. |
| Liquid Cleaners and Degreasers | 7,190 | $681,181 | n.a. |
| Aerosol Spray Cleaning/Degreasing | 170,063 | $16,276,730 | n.a. |
| Paint and Coating Removers (Graffiti Removal) | 105 | $9,412 | n.a. |
| Paint and Coating Removers (Bathtub Refinishing) | 436 | $39,083 | n.a. |
| Paint and Coating Removers (Automotive Repair and Refinishing) | 5,891 | $563,828 | n.a. |
| Paint and Coating Removers (Art Restoration) | 38 | $3,637 | n.a. |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | 1,279 | $121,172 | n.a. |
| Paint and Coating Removers (Professional Contracting) | 622 | $55,756 | n.a. |
| Adhesive and Caulk Remover | 3,986 | $377,634 | n.a. |
| Lithographic Printing Cleaner | 221 | $20,938 | n.a. |
| Dry Cleaning and Spot Removers | 1,391 | $133,133 | n.a. |
| Paint and Coatings | 123 | $11,653 | n.a. |
| Lubricants and Greases | 19,450 | $1,842,693 | n.a. |
| Cold Pipe Insulation | 10,695 | $958,700 | n.a. |
| Anti-spatter Welding Aerosol | 5,992 | $567,682 | n.a. |

For conditions of use that are not otherwise prohibited under this regulation, EPA is requiring that manufacturers (including importers), processors, and distributors, excluding retailers, of methylene chloride and methylene chloride-containing products provide downstream notification of the prohibitions through Safety Data Sheets (SDSs). It is assumed that each of the 6 manufacturers and 26 import/repackage facilities spend 2 hours amending their SDSs to include this notification. The initial costs for downstream notification are $189 per firm and $6,036 in total for the 32 affected manufacturers and importers.

## Reformulation Costs

This section describes the estimated costs for processors who currently formulate products containing methylene chloride and are expected to reformulate their products in response to a risk management option. Reformulation involves changing the composition of a product or otherwise changing the manner in which it is produced, and can include activities such as research and development, laboratory testing, and product re-labeling. Reformulation may be necessary when a chemical use is prohibited (requiring manufacturers to produce alternative products that do not contain the banned chemical) or when a concentration or emission limit is imposed (requiring manufacturers to either produce alternative products that do not contain the banned chemical or to produce a version of the current product that complies with the rule).

Note that manufacturers may comply with a rulemaking by using alternative compliance strategies. For example, if a processor manufactures similar products that are already compliant with the rule, they may switch production away from the non-compliant product without needing to reformulate. On the other hand, if manufacturers only have one product and that product contains the regulated chemical, they will either need to reformulate that product or discontinue production altogether.

It is also important to note that downstream users of the products that are reformulated may also incur costs (or cost savings) when products are reformulated. These costs are not explicitly addressed in this section, but they are discussed below in section 7.12. For example, when reformulation results in higher production costs, some of these costs may be passed on to downstream users. These costs are accounted for and attributed to the producer who reformulated. They are not double-counted as a downstream user cost in such an instance (even though these costs may be ultimately incurred by users). Another example of when downstream users might have costs resulting from reformulation is when the reformulated product is not a perfect drop-in substitute for their use and they need to make changes in how they use the product.

Reformulation costs are dependent on factors such as formulation complexity, reformulation approach, and cost of alternative chemical inputs. Thus, the cost of product reformulation is highly variable. Because information on chemical formulation and production processes are proprietary for many firms, limited data also produce a high degree of uncertainty surrounding reformulation cost estimates.

The bullets below discuss three of the potential strategies for reformulation: substitution and product discontinuation.

* **Substitution.** Substitution for another chemical input will vary in complexity. Products that can use drop-in chemical substitutes may not need extensive production and packaging changes. However, if the substitute is not as easily integrated into the existing product (*e.g.*, if a solid powder is used to replace a liquid), manufacturers may have higher costs related to raw material, research and development, testing, labeling, packaging changes, and/or production changes. As the relative importance (in terms of functional or safety performance) of the regulated chemical increases, it is likely that the number and magnitude of cost components also increases ([RTI 2002](#_ENREF_59)).
* **Product Discontinuation.** If manufacturers anticipate high costs associated with large-scale substitution and/or production changes, the analysis should consider whether those manufacturers will comply with the rule by discontinuing their product line. Since methylene chloride is prohibited in products in several states, many suppliers currently offer a methylene chloride-free version of their products. Because EPA is unsure how often products would be discontinued rather than reformulated, this economic analysis assumes that products will be reformulated.

### Reformulation Cost Components

This analysis identified six reformulation cost components that manufacturers may incur, depending on the type of product and the reformulation approach. These cost components are synthesized from those described in [RTI (2002)](#_ENREF_59) and CARB ([2013](#_ENREF_9)).

1. **Research and product development**. This component involves a technical team identifying the reformulation strategy, developing a new product formula, and evaluating product prototypes. It may also include sourcing any new raw materials and specifying new packaging.
2. **Product performance testing**. Manufacturers may conduct several types of product testing.
   1. Stability testing. Ensures that the new formulation will maintain its composition under a variety of environmental conditions for a reasonable amount of time. This component is particularly applicable if the new formulation requires new packaging, a new chemical input, and/or a production change.
   2. Efficacy testing. Ensures the product performance meets any label claims and established consumer expectations.
   3. Safety testing. Ensures the new formulation is safe for employees to manufacture and transport and for consumers to use and store.
3. **Production and manufacturing changes**. Production changes may include re-tooling of production lines, new technology/equipment, and/or construction of new facilities. Reformulations for minor chemical inputs typically would not require major adjustments to the production process, but more substantial changes may be necessary for reformulations involving critical formulation components. This cost component may include a plant trial to ensure that production changes are feasible. For minor production changes, pilot plant testing (*i.e.,* a small scale version of the full production) may be sufficient and will not require as many resources as a plant trial. Costs may also be incurred to start-up production after the plant trial and to verify that necessary product and production specifications are being met.
4. **Packaging.** Packaging changes are only likely to be necessary if the regulated substance is a critical component.
5. **Labeling.** Labeling modifications may be necessary if product qualities or use instructions change.
6. **Marketing.** Marketing costs may include focus group testing, surveys, advertising, and new technical literature. Market group testing (*e.g.*, focus groups and surveys) will likely not be conducted in most cases; it is likely only to be performed by large companies for high-profile products requiring a major reformulation. Similarly, advertising is likely only a relevant cost if a manufacturer will change its advertising campaign in response to the reformulation (*e.g.*, to emphasize that the product no longer contains the regulated chemical). Updates to the technical literature may be necessary for major attribute changes of the reformulated product (*e.g.*, new use or safety instructions).

Table 7‑5 is adapted from a similar table in [RTI (2002)](#_ENREF_59) and presents suggestions for the types of cost components incurred under each reformulation strategy.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 7‑5: Example Cost Components, by Reformulation Approach | | | |
| Cost Component | Substitution | | Product Discontinuation |
| Non-Critical Component1 | Critical Component2 |
| **Recurring Raw Material Cost** | P | P |  |
| **Research and Product Development** | P | P |  |
| * Stability Testing | P | P |  |
| * Efficacy Testing | P | P |  |
| * Safety Testing |  | P |  |
| * Process Change |  |  |  |
| * Start-up and Verification | P | P |  |
| * Full-Scale Plant Trial |  | P |  |
| * Pilot Plant Testing | P |  |  |
| **Packaging** |  | P |  |
| **Labeling** | P | P |  |
| * Market Group Testing |  |  |  |
| * Technical Literature |  | P |  |
| 1 Components that do not have functional or safety uses (*e.g.,* preservatives, dyes/colorants)  2 Components that have critical functional or safety uses | | | |

EPA has identified three sources that provide reformulation cost estimates. Each source and its limitations is described in the sections below.

#### Cheminfo Services (2006)

[Cheminfo Services (2006)](#_ENREF_15) estimated reformulation costs for 25 categories of automotive aftermarket chemical products for Environment Canada in support of a regulation implementing volatile organic compound (VOC) content limits. These products included adhesives, air fresheners, brake cleaners, engine degreasers, and paint removers. [Cheminfo Services (2006)](#_ENREF_15) sent a questionnaire to 120 companies (55 responses) asking about costs associated with reformulation, with information ultimately provided for 39 products. The manufacturers responded with a wide range of estimated capital costs of reformulation ($0 to $78,000 in 2005 CAN$), with a mean value of $21,707 per product (2005 CAN$). Notably, capital costs for products using a dilution approach to reformulation were reported to be about half those for other reformulation approaches.

There are several limitations to this study. First, [Cheminfo Services (2006)](#_ENREF_15) only reports a single range of reformulation capital costs, so EPA cannot determine how reported costs vary by reformulation approach or product category. For example, dilution was a reformulation method used for 16% of the products in the study, but reformulation costs for dilution cannot be distinguished from reformulation costs for more complex reformulations. Similarly, questionnaire respondents were only asked to provide an estimate for the total reformulation cost, such that EPA cannot determine which cost components the manufacturers considered in their estimates and the relative contribution of each of those components.

However, the mean reformulation value may be a reasonable estimate for reformulating the regulated methylene chloride-containing products. This mean value was used by both the Economic Analysis of the Proposed TSCA Section 6 Action on Trichloroethylene in Dry Cleaning Spot Removers and Aerosol Degreasers (EPA [2016a](#_ENREF_88)) and the Economic Analysis of the TSCA Section 6 Action on Methylene Chloride, Paint and Coating Remover ([EPA 2019](#_ENREF_95)).

#### California Air Resources Board (2013)

The California Air Resources Board (CARB) developed a method to estimate reformulation costs, which it has used to estimate costs for products subject to several of its regulatory actions. These have included consumer products such as solvents, aerosol paint thinners, and aerosol coatings. Appendix J of CARB’s Initial Statement of Reasons for Proposed Rulemaking for Proposed Amendments to the Antiperspirants and Deodorants Regulation, the Consumer Products Regulation, the Aerosol Coating Products Regulation, the Tables of MIR Values, Test Method 310, and Proposed Repeal of the Hairspray Credit Program details the methodology to estimate nonrecurring costs ([CARB 2013](#_ENREF_9)). CARB identified eight phases that manufacturing facilities will implement to produce a compliant product (*e.g.*, product development, labeling modification). For each phase, CARB then identified a set of cost components (*e.g.*, material, personnel, prototype equipment) for which it developed a set of per-product costs. Costs and underlying assumptions were checked with stakeholders to verify reasonableness.

One limitation of CARB’s methodology is that the estimated component costs for each phase were originally developed in 1991 and modified in 1999. These cost estimates were then adjusted to 2012$ using engineering plant cost indices. Production cost estimates from 20-30 years ago may not be representative of reformulation costs in current facilities. For example, “Computer Support” is a separate cost component for several reformulation phases and was potentially a more significant cost in 1991 than it would be presently. Another limitation is that while CARB provides estimated costs for each component, it does not provide the underlying calculations or methodology behind these estimates (*e.g., burden hours, labor mix*).

#### RTI International (2002)

RTI International developed a food and cosmetics reformulation cost module for the U.S. Food and Drug Administration (FDA) ([RTI 2002](#_ENREF_59)). RTI identified a series of cost components that manufacturing facilities may potentially incur when reformulating products to achieve compliance with FDA regulations. Cosmetics manufacturers, industry trade association representatives, and food industry consultants and laboratories were then interviewed to collect the information used to develop the cost estimates. Estimates were based on respondents’ estimates of material costs, burden hours, and wage rates. RTI then built an Excel-based tool that can be used to model reformulation costs based on user inputs (*e.g.*, product category, reformulation type).

To the extent that reformulating food and cosmetics differs from reformulating products subject to a Section 6 action, RTI’s model may not reflect representative reformulation costs for the options being considered in this analysis. RTI’s Excel-based tool only allows users to select products and NAICS codes associated with the food and cosmetics industries and does not allow users to view costs for individual reformulation components. However, RTI’s cost estimates for individual reformulation components are presented in Table 7‑6 and Table 7‑7 based on their underlying data. As with the other sources, the underlying data do not disaggregate component cost estimates by burden hours, wage rates, or material costs.

### Summary of Available Reformulation Unit Cost Estimates

Table 7‑6 and Table 7‑7 present a cross-walked summary of cost estimates from [Cheminfo Services (2006)](#_ENREF_15), CARB ([2013](#_ENREF_9)), and [RTI (2002)](#_ENREF_59) for minor and major modifications, respectively. The cost component estimates for minor modifications in Table 7‑6 approximately correspond to dilution and substitution of non-critical component reformulation approaches. The cost component estimates for major modifications in Table 7‑7 approximately correspond to substitution of critical components (*e.g.*, functional performance or safety uses) and production process changes. Note that EPA used best professional judgement to map estimates from the three sources to a set of consistent cost components and reformulation approaches, as each source differs in how it classifies these components and approaches. Given the degree of uncertainty in each source’s reformulation cost estimates, a low-, high-, and mid- (for [RTI (2002)](#_ENREF_59)) range estimate is presented for each cost component.

The [RTI (2002)](#_ENREF_59) estimates are generally the largest cost estimates, followed by [Cheminfo Services (2006)](#_ENREF_15) and CARB ([2013](#_ENREF_9)). These differences may be the result of any number of differences in methodology or end user industry, as described in the preceding sections. For example, the food and cosmetics products evaluated by [RTI (2002)](#_ENREF_59) may have more sophisticated formulations than the aerosol products evaluated by CARB ([2013](#_ENREF_9)). Or, differences in regulatory requirements and/or consumer expectations for food and cosmetic products as compared to automotive products may incentivize food and cosmetic manufacturers to invest more in the research and development and marketing phases.

The total cost estimates presented in the tables do not include recurring costs associated with changes in a product’s raw materials. Cost estimates for each source are inflated to 2020$ using the Consumer Price Index. Because EPA could not identify the dollar-year for the estimates presented in [RTI (2002)](#_ENREF_59), it is assumed that estimates are presented in 2001$.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table 7‑6: Crosswalk of Per-Formula Component Cost Estimates (2022$) - Minor Modification1 | | | | | | | |
| Cost Component | ChemInfo2 | | CARB3 | | RTI4 | | |
| Low | High | Low | High | Low | Mid | High |
| **Research and Product Development** | - | - | $206 | $8,044 | $12,473 | $52,891 | $106,246 |
| **Product Performance Testing** | | | | | | | |
| -Stability Testing | - | - | - | $1,856 | $1,063 | $3,657 | $8,842 |
| -Efficacy Testing | - | - | - | $1,856 | - | - | - |
| -Safety Testing | - | - | - | $4,331 | - | - | - |
| **Production and Manufacturing Changes** | | | | | | | |
| -Process Change | - | - | - | $2,062 | - | - | - |
| -Start-up and Verification | $1,841 | $9,204 | $20,294 |
| -Plant Testing | - | - | - |
| **Packaging** | - | - | - | - | - | - | - |
| **Labeling** | - | - | - | $1,856 | - | - | - |
| **Marketing** | | | | | | | |
| -Market Group Testing | - | - | - | $619 | - | - | - |
| -Technical Literature | - | - | - | $412 | - | - | - |
| **TOTAL** | **$0** | **$27,906** | **$206** | **$21,037** | **$15,376** | **$65,752** | **$135,383** |
| A dash "-" indicates that the source did not estimate costs for that component 1 Corresponds to dilution and substitution of non-critical component strategies (*e.g.*,dyes/colorants, preservatives). 2 Low and high estimates correspond to minimum and mean capital cost estimates from [Cheminfo Services (2006)](#_ENREF_15), respectively. 3 Corresponds to the Low Cost estimates from CARB ([2013](#_ENREF_9)) (Tables J-1 to J-3). The low estimate is the minimum Low Cost estimate of three product types (adhesive, aerosol multi-purpose solvent & paint thinner, aerosol coating), and the high estimate is the maximum Low Cost estimate of the three product types.  4 Corresponds to estimates for minor non-critical ingredients from [RTI (2002)](#_ENREF_59). | | | | | | | |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table 7‑7: Crosswalk of Per-Formula Component Cost Estimates (2022$) - Major Modification1 | | | | | | | |
| Cost Component | ChemInfo2 | | CARB3 | | RTI4 | | |
| Low | High | Low | High | Low | Mid | High |
| **Research and Product Development** | - | - | $8,044 | $27,225 | $49,882 | $211,561 | $424,983 |
| **Product Performance Testing** | | | | | | | |
| -Stability Testing | - | - | $1,856 | $9,487 | $4,247 | $14,626 | $35,370 |
| -Efficacy Testing | - | - | $1,856 | $7,837 | - | - | - |
| -Safety Testing | - | - | $4,331 | $14,025 | $3,305 | $9,419 | $34,702 |
| **Production and Manufacturing Changes** | | | | | | | |
| -Process Change | - | - | - | $2,062 | $3,905 | $12,916 | $28,532 |
| -Start-up and Verification | $7,363 | $36,819 | $180,324 |
| -Plant Testing | $5,566 | $20,294 | $172,787 |
| **Packaging** | - | - | - | - | $10,262 | $27,307 | $51,310 |
| **Labeling** | - | - | $1,650 | $1,856 | - | - | - |
| **Marketing** | | | | | | | |
| -Market Group Testing | - | - | $619 | $2,062 | $66,099 | $115,674 | $190,036 |
| -Technical Literature | - | - | - | $412 | - | - | - |
| **TOTAL** | **$27,906** | **$100,276** | **$18,356** | **$64,966** | **$150,629** | **$448,616** | **$1,118,043** |
| A dash "-" indicates that the source did not estimate costs for that component 1 Corresponds to substitution of critical component and manufacturing process change strategies. 2 Low and high estimates correspond to mean and maximum capital cost estimates from [Cheminfo Services (2006)](#_ENREF_15), respectively. 3 Correspond to the High Cost estimates from CARB ([2013](#_ENREF_9)) (Tables J-1 to J-3). The low estimate is the minimum High Cost estimate of three product types (adhesive, aerosol multi-purpose solvent & paint thinner, aerosol coating), and the high estimate is the maximum High Cost estimate of the three product types. 4 Corresponds to estimates for major ingredients and production process changes from [RTI (2002)](#_ENREF_59). | | | | | | | |

### Reformulation Unit Costs Used in this Analysis

This analysis considered two different reformulation costs, which vary according to how complex the reformulation process is expected to be. The main source for the reformulation costs used in this analysis is CARB’s ([2013](#_ENREF_9)) analysis. EPA selected the CARB estimates as the primary basis for the reformulation costs because they were developed for the same types of products considered in this analysis. In addition, since the CARB estimates are disaggregated by type of cost, they can more easily accommodate adjustments to reflect more or less complex reformulations. While the [Cheminfo Services (2006)](#_ENREF_15) estimates also pertain to similar types of products, there is no way to separate the costs for simpler dilution reformulations and those that are more complex. EPA believes that the RTI ([2002](#_ENREF_59)) estimates, which were developed for reformulating food and cosmetics products, are likely to reflect higher reformulation costs than would be expected for the types of products considered in this analysis. However, EPA does use some of the RTI ([2002](#_ENREF_59)) estimates’ cost components to estimate reformulation costs for those products that are expected to require complex reformulations.

Table 7‑8 presents the reformulation costs considered in this analysis. For each of the use categories where reformulation is expected to be necessary, this analysis uses the standard substitution reformulation cost. This estimate is based on CARB’s highest reformulation cost estimate.

|  |  |
| --- | --- |
| Table 7‑8: Reformulation Costs Used in this Analysis (2022$) | |
| Cost Component | Standard Substitution Reformulation Cost |
| **Research and Product Development** | $27,225 |
| •      Stability Testing | $9,487 |
| •      Efficacy Testing | $7,837 |
| •      Safety Testing | $14,025 |
| •      Process Change | $2,062 |
| •      Start-up and Verification | $0 |
| •      Plant Testing | $0 |
| **Packaging/Labeling** | $1,856 |
| •      Market Group Testing | $2,062 |
| •      Technical Literature | $412 |
| **TOTAL** | **$64,966** |

Table 7‑9 indicates which of the reformulation costs correspond to each of the use categories considered in the analysis. As indicated, vapor degreasers are assumed to switch to different cleaning methods that use existing cleaning agents or to a vapor degreasing method using an existing vapor degreasing fluid. For all other use categories, the analysis assumes that the standard substitution reformulation costs are incurred.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 7‑9: Reformulation Costs by Use Category | | | |
| Use Category | Product Discontinuation | Standard Substitution Reformulation  Cost | Notes |
|  | ($0) | ($64,966) |  |
| Vapor degreasing and batch cold cleaning fluids | ✓ |  | EPA assumes that vapor degreasers will switch to vapor degreasing fluids that already exist, or switch to a different cleaning method. |
| All other product formulations |  | ✓ | Since alternatives already exist, EPA assumes the standard substitution reformulation costs for these products. |
| Sources: CARB ([2013](#_ENREF_9)) and [RTI (2002)](#_ENREF_59) | | | |

### Summary of Estimated Total Reformulations Costs by Use Category

Table 7‑10 presents the estimated costs for the reformulation of products under the prohibition of methylene chloride. Note that EPA assumes a prohibition of methylene chloride use in vapor degreasing would result in switching to other cleaning methods and/or solvents that currently exist and therefore would not require any reformulation.

|  |  |  |
| --- | --- | --- |
| Table 7‑10: Total Reformulation Costs | | |
| Use Category | Products Reformulated | Total Reformulation Costs  (Initial Costs, $64,966 per product) |
| Liquid Cleaners and Degreasers | 3 | $194,898 |
| Aerosol Spray Cleaning/Degreasing | 8 | $519,728 |
| Paint and Coating Removers | 7 | $454,762 |
| Adhesive and Caulk Remover | 2 | $129,932 |
| Lithographic Printing Cleaner | 4 | $259,864 |
| Dry Cleaning and Spot Removers | 1 | $64,966 |
| Paint and Coatings | 123 | $7,990,818 |
| Glues, Sealants, Adhesives, and Caulks | 72 | $4,677,552 |
| Lubricants and Greases | 6 | $389,796 |
| Cold Pipe Insulation | 1 | $64,966 |
| Anti-spatter Welding Aerosol | 15 | $974,490 |
| **All Conditions of Use** | **242** | **$15,721,772** |

## Costs for Switching to Alternatives to Methylene Chloride as a Processing Aid

Three users of methylene chloride as a processing aid provided estimated costs for switching to alternatives in their comments on the proposed rule, estimating the costs of switching to be $47, $40, and $90 million ([Celanese Corporation 2023](#_ENREF_13); [Halocarbon 2023](#_ENREF_22); [Lanxess Corporation 2023](#_ENREF_36)). EPA used the approximate average of these three estimates, $60 million, as the estimated costs for switching to alternatives under Option 2 for the 44 affected sites. This results in a total annualized cost of $166 million using a 3 percent discount rate and $228 million using a 7 percent discount rate.

## Costs for Switching to Alternatives to Methylene Chloride Vapor Degreasing

Methylene chloride is not commonly used as a vapor degreasing solvent, but EPA estimates there are 17 facilities nationwide that use methylene chloride for vapor degreasing. Manufacturers of vapor degreasing machines told EPA during industry consultations that they no longer manufacture machines designed to be used with methylene chloride, which implies that when the existing methylene chloride vapor degreasing machines reach the end of their useful life, they are likely to be replaced with machines designed to use a different solvent or cleaning method.

EPA consulted with critical cleaning experts Barbara Kanegsberg and Ed Kanegsberg of BFK Solutions about the costs of switching to alternatives to methylene chloride in vapor degreasing. BFK Solutions helps manufacturers develop and/or optimize their cleaning processes. According to these experts, the alternatives that would be technologically and economically feasible would primarily depend on:

* the soils being removed,
* the level of cleanliness required,
* the characteristics of the components being cleaned,
* the volume of components being cleaned,
* and other factors.

Trial and error also add uncertainty to transition costs of an alternative cleaning process. Users may need to test multiple different cleaning processes before identifying a successful process.

BFK Solutions provided expert estimates of the costs of switching from the use of methylene chloride in different sized degreasers used in the different cleaning categories in the first two columns of Table 7‑11 and the different cleaning methods presented the last column in Table 7‑11 .

For this analysis, degreasers are defined as small, medium or large based on the cleaning chamber tank size. Dimensions for the size categories are small–12 in. x 12 in. x 10 in.; medium–36 in. x 36 in. x 22 in.; large–60 in. x 42 in. x 36 in.).

This economic analysis defines four “cleaning categories” that would need different processes and cleaning requirements for switching to an alternative cleaning method from vapor degreasing with methylene chloride. These terms are defined relative to the expected end-use of the product and consequences of inadequate or inappropriate cleaning.

* **General Cleaning** is defined as having relatively low process development and low cost of process verification. Primary costs will include equipment and performance testing.
* **High Precision Cleaning** covers the cleaning of high value parts where very small residue is acceptable, at best. Significant process development is needed; customer or other regulatory performance standards may be the driving force. Primary costs will include evaluation, initial and on-going performance testing and capital costs.
* **Safety Critical Cleaning** includes product processes where performance failure is not an acceptable option, because failure poses dire hazards for patient, public safety, or national security and/or because the cost of failure would be prohibitively high (e.g., space flight). This category will have higher costs for process verification and validation and may also cover situations with very high-cost consequences of failure. Primary costs will include evaluation, initial performance testing, cleanliness validation/verification, and capital costs.
* **Start-up/R&D Critical Cleaning** covers the development process of new high precision or high value products prior to production; these would typically not require large degreasers and would need adaptable cleaning systems and perhaps multiple cleaning systems.

The list of cleaning methods in Table 7‑11 is not exclusive. There are additional cleaning methods using CO2, laser, and plasma that have not been included because they would be unlikely to be the primary method to replace a baseline method. They may become needed as additional methods in order to achieve required cleanliness specifications. Each method that is used will incur equipment and process development costs.

| Table 7‑11: Sizes, Cleaning Categories, and Cleaning Methods Considered in the Vapor Degreasing Cost Analysis | | | | |
| --- | --- | --- | --- | --- |
| Size |  | Cleaning Category |  | Cleaning Method |
| Small |  | General |  | Baseline - OTVD with methylene chloride |
| Medium |  | High Precision |  | Replace with Airless Degreaser with PCE |
| Large |  | Safety Critical |  | Convert OTVD to use Flashpoint inerted t-DCE |
|  | | Start-Up/R&D |  | Replace with OTVD using FlashPoint inerted t-DCE |
|  | |  |  | Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) |
|  | |  |  | OTVD for Low boiling point (<100C) Alcohol or other flammable |
|  | |  |  | OTVD for Very low flashpoint (<0C) solvent |
|  | |  |  | EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols |
|  | |  |  | Co-Solvent, Bi-Solvent |
|  | |  |  | High boiling, non-vacuum, non-rinse |
|  | |  |  | Semi-Aqueous |
|  | |  |  | Replace with Aqueous Cleaning |
|  | |  |  | Hybrid system (example: Inventec, HEMO) |

Table 7‑12 presents the descriptions of the baseline and alternative cleaning methods considered in this analysis.

| Table 7‑12: Cleaning Methods and Their Definitions | |
| --- | --- |
| Cleaning Method | Definition |
| Baseline - OTVD with methylene chloride | An OTVD uses heated solvent in the liquid and/or vapor phase. For this analysis, the baseline OTVD uses methylene chloride as the solvent. An OTVD may or may not have a cover. It may be characterized by the equipment supplier using terms like “well-sealed” or having “minimal solvent emissions.” As defined here, OTVDs have an atmospheric air-solvent interface, which is why it is difficult to meet the low emissions required by the methylene chloride ECEL. Some but not all current OTVDs using methylene chloride may be the same as “National Emission Standards for Hazardous Air Pollutants (NESHAP) compliant” OTVDs, in that they may have double-coils and a high freeboard ratio. An OTVD may include ultrasonic cleaning and/or a spray wand. |
| Airless Degreaser with PCE | An airless degreaser (sometimes referred to as an airless/airtight cleaning system) is equipment for which there is never an atmospheric air-solvent interface. Solvent does not enter the working chamber until the product to be cleaned has been placed in the chamber, the chamber has been sealed and air has been evacuated, usually to a level of one torr or less. Cleaning then can occur, usually by computer control, either by immersion (with or without ultrasonics), spray, or vapor degreasing. As with aqueous cleaning, solvent immersion cleaning could also include cyclic nucleation or cyclic cavitation, where the pressure is changed to provide boiling cycles. Following cleaning and rinsing cycles, the solvent is pumped back into sealed reservoirs, and the chamber is again pumped to a vacuum (sometimes through a carbon filter to capture residual traces of solvent vapors), thus providing vacuum drying. A closed-loop degreaser is not the same as an airless degreaser. While an OTVD that recirculates/redistills/reuses the solvent may be described as “closed loop”, such systems have not been demonstrated to match the low level of solvent loss achieved with an airless system. |
| Convert OTVD to use Flashpoint inerted t-DCE | An OTVD uses heated solvent in the liquid and/or vapor phase. For these cleaning methods, flashpoint inerted trans-dichloroethylene (trans-DCE) is the solvent. An OTVD may or may not have a cover. It may be characterized by the equipment supplier using terms like “well-sealed” or having “minimal solvent emissions.” Since flashpoint inerted trans DCE blends are more expensive, it may make sense for users to replace their OTVD if their existing machine is an older, more emissive model. Trans-DCE is currently undergoing Risk Evaluation by TSCA. The fluorinated inerting agents are also under scrutiny by the U.S. EPA and other regulators because of concerns about PFAS. |
| Replace with OTVD using Flashpoint inerted t-DCE |
| Solstice® system (trans-1-chloro-3,3,3,trifluoropropene) | An OTVD uses heated solvent in the liquid and/or vapor phase. For these cleaning methods, trans-1-chloro-3,3,3,trifluoropropene is the solvent. An OTVD may or may not have a cover. Because Solstice® has a low boiling point, the specifically designed OTVD may be characterized by the equipment supplier using terms like “well-sealed” or having “minimal solvent emissions.” Since trans-1-chloro-3,3,3,trifluoropropene blends are volatile and more expensive, it is very unlikely to be used as a “drop-in” in OTVDs currently in use for chlorinated or brominated solvents. |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | These systems are vapor degreasers where engineering controls have been employed to eliminate ignition and oxidation sources in order to ensure that flammable liquids can be used. They are certified to meet fire protection standards. Examples of low flashpoint solvents include simple alcohols like methanol, ethanol, and propanol. An azeotrope of cyclohexane with isopropanol has also been used. The most common very low flashpoint solvent is acetone. It should be noted that, with the exception of acetone, these other solvents are considered to be VOCs, and have restrictions in areas of poor air quality. |
| OTVD for Very low flashpoint (<0C) solvent |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | These are systems containing combustible (flashpoint > 37.8C) solvents, with boiling points greater than 100C. The solvents in current use are either medium chain (~10-12 carbons) iso-paraffins or those that are called “modified alcohols”, such as iso-propanol connected to a butane (4-carbon) chain. Because the primary concern is reducing flammability concerns rather than toxic exposure, these systems are likely to be the same as airless degreasers, but need not be designed to completely eliminate the emissions to the degree required from chlorinated and brominated solvents. |
| Co-Solvent, Bi-Solvent | These are systems that use two organic solvents. For the purposes of this analysis, the terms Co-Solvent and Bi-Solvent are interchangeable. In some cases, the cleaning agent (sometimes referred to as the solvating agent) is in one chamber and the rinsing agent (sometimes referred to as the displacement agent) is in a second tank and is used sequentially. In other designs, the washing step is a mixture of cleaning agent and displacement agent.  **Rinsing/displacement with Flashpoint-inerted trans DCE**  Typically, a plant-based ester (such as a soy methyl ester is used as the cleaning or solvating agent. Nearly all current co-solvent or bi-solvent systems use flashpoint-inerted trans DCE as the displacement agent. The fluorinated inerting agents are also under scrutiny because of concerns about PFAS.  **Rinsing/displacement with alcohol (cost estimates do not reflect this possibility)**  If ingredients of flashpoint-inerted trans DCE were to become unavailable through regulatory actions or business decisions, co-solvent and bi-solvent systems are options. Barbara Kanegsberg conducted cleaning studies at Litton Guidance and Control Systems in the late 1980s- early 1990s for what we now term safety/critical military applications. Cleaning was demonstrated using cleaning agents such as d-limonene or high-boiling hydrocarbon blends followed by repeated rinsing with isopropyl alcohol. The processes were more readily and consistently accomplished using perfluorocarbons which could not be used today. These processes involved manual cleaning by highly-specialized technicians along with 100% inspection. Because current bi—solvent and co-solvent processes involve flashpoint-inerted trans-DCE as the rinsing/displacement agent, additional process development, including testing, would be needed. Low flashpoint cleaning systems would be needed – this would add to equipment costs. |
| High boiling, non-vacuum, non-rinse | This method is limited to a few general cleaning applications where cleaning agent residue could be tolerated. Examples of solvents used in such systems include d-limonene and soy methyl esters. The FP is above 37.8 deg C (100 deg F), so they would be considered not flammable by NFPA. Equipment would consist of a dip tank, most often but not necessarily heated. There could be ultrasonics or agitation. Depending on local regulations (notably those restricting VOC), there may or may not be a cover. Examples:   * D-limonene (aliphatic hydrocarbon classified as a cyclic monoterpene, the major component in oils from citrus rinds) * flashpoint 48 deg C * boiling point 176 Deg C * Methyl Soyate (a mixture of long-chain, typically 16-18 carbons, fatty acid methyl esters) * flashpoint 130C * boiling point 200C |
| Semi-Aqueous | A semi-aqueous cleaning process consists of a water-miscible blend, with high solvent concentration (including emulsions), used as an immersion or spray followed by an aqueous rinse (see the description of aqueous process). Some semi-aqueous processes are referred to as aqueous (by the supplier of cleaning agent, or cleaning equipment, or by the end-user, in part because there is not a clear demarcation of the line between an aqueous additive package and a water-rinseable solvent. Equipment costs are high. Carryover of solvent into the rinse tank can be a problem. |
| Aqueous Cleaning | Aqueous cleaning involves washing with a cleaning agent that could be water alone but that typically contains organic and inorganic chemistry. The quality of the water and the amount of water used is highly variable. Depending on the application, the water quality can range from tap water to purified water, for example, de-ionized or reverse osmosis.  Aqueous formulations vary in their composition (organic and inorganic additives), the pH, and the concentration at which they are used. What is described as an aqueous process may actually be a semi-aqueous process, in large part because it has become more acceptable to avoid the concept of using any organic solvent for cleaning.  Heat and various types of cleaning action like ultrasonics, underwater agitation (like a jacuzzi or tubulation) may be used to enhance cleaning. In most instances there is significant amount of rinsing with water to displace the cleaning agent. In some instances, the rinse water may include chemicals (rust preventative (RP)) to forestall corrosion. Depending on the substrate to be cleaned and the end-use of the product, there is most often a drying step. In our model for cost comparison, we have used a wash tank followed by rinse tanks followed by a drying chamber. While we have used immersion tanks as a model to describe the aqueous process to allow comparison among the cleaning processes, in fact there is an enormous variability in aqueous cleaning processes and aqueous cleaning equipment.  The cost analyses generally consider aqueous systems to consist of one or two wash tanks followed by HOW MANY rinse tanks and a dryer. Here are a few non-encompassing examples of aqueous cleaning equipment that are not a sequence of cleaning tanks. For general cleaning applications, cleaning agent may be applied to the part either by spray or immersion. Rinsing, if it occurs may be as simple as holding the part under a tap and rinsing all residue down the drain. In some metal cleaning, the part may be washed in a spray chamber, with or without rinsing. Where rinsing occurs, it may be accomplished by placing the part over a grate and spraying water on it. Drying may not be necessary. In-line aqueous cleaning equipment is widely used to remove “no-clean” (low residue) flux from electronics assemblies, post-soldering. The cleaning action (washing and rinsing) typically involves spray-in-air. There are wash, rinse, and drying chambers. In some applications such as in some hybrid cleaning water (and/or an aqueous cleaner) is introduced into a chamber containing the parts to be cleaned. Ultrasonic cleaning and/or in cyclic cavitation (cyclic nucleation) may be used to enhance cleaning. |
| Hybrid system (e.g., Inventec, HEMO) | Hybrid systems use two or more cleaning methods in a single piece of cleaning equipment. Sometimes, the parts are cleaned in a single chamber and cleaning solutions are introduced. Other systems use sequential chambers. One equipment manufacturer described the use of an aqueous cleaning step but with a solvent rinse. This would be distinguished from a semi-aqueous process where the high-solvent cleaner is used for washing and water used for rinsing. As contrasted with co-solvent or bi-solvent systems, hybrid systems, in our definition, use an aqueous process as one of the methods, either sequentially or together as an emulsion. |

The critical cleaning experts provided two sets of estimates that they described as “optimistic” and “realistic”. The “realistic” estimates accounted for additional trial and error in identifying and implementing the new cleaning processes and these are the estimates presented and used in this economic analysis.

The categories of costs presented in Table 7‑13 were considered in the analysis.

| Table 7‑13: Categories of Costs Considered in the Vapor Degreasing Cost Analysis |
| --- |
| Cost Categories Considered |
| Process Development for Identifying and Implementing the Alternative Cleaning Process (section 7.8.1) |
| Initial Capital Costs for New Machine (section 7.8.2) |
| Initial Capital Costs aside from New Machine (section 7.8.3) |
| Cleaning Agent Costs (section 7.8.4) |
| Waste Disposal Costs (section 7.8.5) |
| Annual Maintenance Costs (section 7.8.6) |
| Annual Labor Costs (section 7.8.7) |
| Electrical Costs (section 7.8.8) |
| Additional Floorspace (section 7.8.9) |

EPA developed estimates of the baseline mix of cleaning categories by using the 17 sites using methylene chloride for vapor degreasing in the identified in the National Emissions Inventory ([EPA 2020a](#_ENREF_96)). EPA classified each of these facilities as performing high precision cleaning (64.7% of facilities), safety critical cleaning (17.6% of facilities), or general cleaning (17.6%). Since R&D cleaning facilities are unlikely to have releases that meet reporting thresholds, EPA assumed that they would be missing from the National Emissions Inventory data and assumed that R&D cleaning facilities represent 5% of the total. This suggests that the total fraction in each category is:

* Safety critical: 17%
* High precision: 61%
* General: 17%
* R&D: 5%

EPA also estimated the baseline mix of small, medium, and large facilities using the methylene chloride emissions reported in National Emissions Inventory from vapor degreasers. Based on the estimates presented below in sections 7.8.4 and 7.8.5, liquid waste represents 47% of total solvent consumption. Thus, the NEI emissions were divided by 53% (53% = 1 - 47%) to estimate consumption and then mapped to the nearest size category according to the consumption estimates described in section 7.8.4, below. Based on these estimates the mix of small, medium, and large facilities is estimated to be 10%, 40%, and 50%, respectively. These baseline estimates are presented in Table 7‑14.

| Table 7‑14: Estimated Baseline Mix for Size and Type | |
| --- | --- |
| Size, Type, or Size/Type Combined | Estimated Baseline Percentage |
| Size | |
| Small | 10% |
| Medium | 40% |
| Large | 50% |
| Type | |
| General Cleaning | 17% |
| High Precision Cleaning | 61% |
| Safety Critical Cleaning | 17% |
| R&D Critical Cleaning | 5% |
| Size/Type Combined | |
| Small/General Cleaning | 1.7% |
| Medium/General Cleaning | 6.8% |
| Large/General Cleaning | 8.5% |
| Small/High Precision Cleaning | 6.1% |
| Medium/High Precision Cleaning | 24.4% |
| Large/High Precision Cleaning | 30.5% |
| Small/Safety Critical Cleaning | 1.7% |
| Medium/Safety Critical Cleaning | 6.8% |
| Large/Safety Critical Cleaning | 8.5% |
| Small/Start-Up/R&D Critical Cleaning | 1.0% |
| Medium/Start-Up/R&D Critical Cleaning | 4.0% |

An estimate or assumption about the mix of alternative cleaning methods is also needed to estimate the costs for switching cleaning methods. EPA asked critical cleaning experts who help manufacturers develop and/or optimize their cleaning processes to estimate a percentage weight for each alternative cleaning method that indicates how likely affected vapor degreasers would be to adopt each method. They provided two sets of percentages, one under a scenario where trans-DCE was considered a viable alternative cleaning method and a second scenario where it is was not. Note that the estimated percentage weights intentionally sum to more than 100% to account for instances where a facility switches from using methylene chloride vapor degreasing to multiple cleaning methods. These percentages are presented below in section 7.8.10.

### Process Development for Identifying and Implementing the Alternative Cleaning Process

The process of identifying and implementing alternative cleaning processes is complex and includes the following types of activities:

* Consulting with customers
* Consulting with suppliers
* Researching cleaning options (web-search, talk to vendors, attend webinars, trade shows)
* Obtaining and reviewing equipment costs
* Selecting, obtaining and shipping representative hardware samples for test at vendor
* Consulting with insurance carrier and fire department
* Conducting, evaluating and reviewing cleanliness tests
* Management review
* Refining equipment and process design
* Making facilities changes
* Setting up and performance testing new equipment
* Process validation
* Employee training

EPA asked BFK Solutions to estimate these process development costs and two sets of costs were provided: (1) optimistic and (2) realistic. The realistic set of estimates are used in this economic analysis.

As presented in Table 7‑15, the estimated initial costs associated with the development and implementation of alternative cleaning processes range from $100,000 to $1,540,000. The 25th, 50th, and 75th percentile for the estimated incremental costs are about $170,000, $340,000, and $1,100,000 respectively.

| Table 7‑15: Process Development for Identifying and Implementing the Alternative Cleaning Process | |
| --- | --- |
| Size Cleaning Category; Alternative Cleaning Method | Estimated Initial Costs (2022$) |
| General Cleaning of All Sizes; convert to aqueous | $100,000 |
| General Cleaning of All Sizes; convert to cleaning methods other than aqueous | $170,000 |
| High Precision Cleaning of All Sizes; convert to aqueous | $290,000 |
| High Precision Cleaning of All Sizes; convert to cleaning methods other than aqueous | $340,000 |
| R&D Critical Cleaning of All Sizes; all cleaning methods | $410,000 |
| Safety Critical of All Sizes; convert to aqueous | $1,100,000 |
| Safety Critical of All Sizes; convert to cleaning methods other than aqueous | $1,540,000 |

### Initial Capital Costs for New Machine

Machine costs were estimated by looking at currently available new machines on the market and/or used machines available for purchase. Table 7‑16 presents the estimated initial costs associated with purchasing a new machine or upgrading an existing machine. When these initial costs are incurred, they range from $4,000 to $6.7 million.

| Table 7‑16: Initial Capital Costs for New Machine, by Size, Cleaning Category, and Alternative Cleaning Method | | |
| --- | --- | --- |
| Size/Cleaning Category | Alternative Cleaning Method | Estimated Initial Costs (2022$) |
| Small/General Cleaning | Replace with Airless Degreaser with PCE | $280,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $0 |
| Replace with OTVD using FlashPoint inerted t-DCE | $60,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $90,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $160,000 |
| OTVD for Very low flashpoint (<0C) solvent | $160,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $280,000 |
| Co-Solvent, Bi-Solvent | $440,000 |
| High boiling, non-vacuum, non-rinse | $4,000 |
| Semi-Aqueous | $100,000 |
| Replace with Aqueous Cleaning | $240,000 |
| Hybrid system (e.g., Inventec, HEMO) | $392,000 |
| Medium/General Cleaning | Replace with Airless Degreaser with PCE | $480,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $0 |
| Replace with OTVD using Flashpoint inerted t-DCE | $380,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $540,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $500,000 |
| OTVD for Very low flashpoint (<0C) solvent | $500,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $480,000 |
| Co-Solvent, Bi-Solvent | $500,000 |
| High boiling, non-vacuum, non-rinse | $16,000 |
| Semi-Aqueous | $400,000 |
| Replace with Aqueous Cleaning | $500,000 |
| Hybrid system (e.g., Inventec, HEMO) | $672,000 |
| Large/General Cleaning | Replace with Airless Degreaser with PCE | $4,800,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $0 |
| Replace with OTVD using Flashpoint inerted t-DCE | $3,600,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $5,400,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $4,800,000 |
| OTVD for Very low flashpoint (<0C) solvent | $4,800,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $4,800,000 |
| Co-Solvent, Bi-Solvent | $288,000 |
| High boiling, non-vacuum, non-rinse | $32,000 |
| Semi-Aqueous | $160,000 |
| Replace with Aqueous Cleaning | $4,800,000 |
| Hybrid system (e.g., Inventec, HEMO) | $6,720,000 |
| Small/High Precision Cleaning | Replace with Airless Degreaser with PCE | $280,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $0 |
| Replace with OTVD using Flashpoint inerted t-DCE | $60,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $90,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $160,000 |
| OTVD for Very low flashpoint (<0C) solvent | $160,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $280,000 |
| Co-Solvent, Bi-Solvent | $220,000 |
| Semi-Aqueous | $100,000 |
| Replace with Aqueous Cleaning | $260,000 |
| Hybrid system (e.g., Inventec, HEMO) | $292,000 |
| Medium/High Precision Cleaning | Replace with Airless Degreaser with PCE | $480,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $0 |
| Replace with OTVD using Flashpoint inerted t-DCE | $360,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $540,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $500,000 |
| OTVD for Very low flashpoint (<0C) solvent | $50,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $480,000 |
| Co-Solvent, Bi-Solvent | $480,000 |
| Semi-Aqueous | $400,000 |
| Replace with Aqueous Cleaning | $500,000 |
| Hybrid system (e.g., Inventec, HEMO) | $672,000 |
| Large/High Precision Cleaning | Replace with Airless Degreaser with PCE | $4,800,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $0 |
| Replace with OTVD using Flashpoint inerted t-DCE | $3,600,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $5,400,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $4,800,000 |
| OTVD for Very low flashpoint (<0C) solvent | $4,800,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $4,800,000 |
| Co-Solvent, Bi-Solvent | $3,200,000 |
| Semi-Aqueous | $160,000 |
| Replace with Aqueous Cleaning | $4,800,000 |
| Hybrid system (e.g., Inventec, HEMO) | $6,720,000 |
| Small/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $280,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $12,000 |
| Replace with OTVD using Flashpoint inerted t-DCE | $60,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $90,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $160,000 |
| OTVD for Very low flashpoint (<0C) solvent | $160,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $280,000 |
| Co-Solvent, Bi-Solvent | $220,000 |
| Semi-Aqueous | $100,000 |
| Replace with Aqueous Cleaning | $60,000 |
| Hybrid system (e.g., Inventec, HEMO) | $392,000 |
| Medium/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $480,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $144,000 |
| Replace with OTVD using Flashpoint inerted t-DCE | $360,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $540,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $500,000 |
| OTVD for Very low flashpoint (<0C) solvent | $500,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $480,000 |
| Co-Solvent, Bi-Solvent | $480,000 |
| Semi-Aqueous | $400,000 |
| Replace with Aqueous Cleaning | $500,000 |
| Hybrid system (e.g., Inventec, HEMO) | $672,000 |
| Large/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $4,800,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $720,000 |
| Replace with OTVD using Flashpoint inerted t-DCE | $3,600,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $5,400,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $4,800,000 |
| OTVD for Very low flashpoint (<0C) solvent | $4,800,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $4,800,000 |
| Co-Solvent, Bi-Solvent | $4,800,000 |
| Semi-Aqueous | $1,600,000 |
| Replace with Aqueous Cleaning | $4,800,000 |
| Hybrid system (e.g., Inventec, HEMO) | $6,700,000 |
| Small/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | $280,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $0 |
| Replace with OTVD using Flashpoint inerted t-DCE | $60,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $90,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $160,000 |
| OTVD for Very low flashpoint (<0C) solvent | $160,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $280,000 |
| Co-Solvent, Bi-Solvent | $220,000 |
| Semi-Aqueous | $100,000 |
| Replace with Aqueous Cleaning | $60,000 |
| Medium/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | $480,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $0 |
| Replace with OTVD using Flashpoint inerted t-DCE | $720,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $540,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $500,000 |
| OTVD for Very low flashpoint (<0C) solvent | $500,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $480,000 |
| Co-Solvent, Bi-Solvent | $480,000 |
| Semi-Aqueous | $400,000 |
| Replace with Aqueous Cleaning | $500,000 |

### Other Initial Capital Costs

Non-machine initial costs may include costs for fire equipment. The cost was estimated as 25% of the machine cost in most cases.

Table 7‑17 presents the estimated initial capital costs other than the costs of purchasing a new machine or upgrading an existing machine. When these initial costs are incurred, they range from $400 to $1.2 million.

| Table 7‑17: Other Initial Capital Costs by Size, Cleaning Category, and Alternative Cleaning Method | | |
| --- | --- | --- |
| Size/Cleaning Category | Alternative Cleaning Method | Estimated Initial Costs (2022$) |
| Small/General Cleaning | Replace with Airless Degreaser with PCE | $28,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $18,000 |
| Replace with OTVD using Flashpoint inerted t-DCE | $9,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $18,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $16,000 |
| OTVD for Very low flashpoint (<0C) solvent | $32,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $70,000 |
| Co-Solvent, Bi-Solvent | $22,000 |
| High boiling, non-vacuum, non-rinse | $800 |
| Semi-Aqueous | $10,000 |
| Replace with Aqueous Cleaning | $3,333 |
| Hybrid system (e.g., Inventec, HEMO) | $39,200 |
| Medium/General Cleaning | Replace with Airless Degreaser with PCE | $28,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $54,000 |
| Replace with OTVD using Flashpoint inerted t-DCE | $0 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $0 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $0 |
| OTVD for Very low flashpoint (<0C) solvent | $0 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $120,000 |
| Co-Solvent, Bi-Solvent | $0 |
| High boiling, non-vacuum, non-rinse | $0 |
| Semi-Aqueous | $10,000 |
| Replace with Aqueous Cleaning | $10,000 |
| Hybrid system (e.g., Inventec, HEMO) | $39,200 |
| Large/General Cleaning | Replace with Airless Degreaser with PCE | $28,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $6,000 |
| Replace with OTVD using Flashpoint inerted t-DCE | $9,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $0 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $16,000 |
| OTVD for Very low flashpoint (<0C) solvent | $16,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $1,200,000 |
| Co-Solvent, Bi-Solvent | $22,000 |
| High boiling, non-vacuum, non-rinse | $400 |
| Semi-Aqueous | $10,000 |
| Replace with Aqueous Cleaning | $180,000 |
| Hybrid system (e.g., Inventec, HEMO) | $39,200 |
| Small/High Precision Cleaning | Replace with Airless Degreaser with PCE | $28,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $18,000 |
| Replace with OTVD using Flashpoint inerted t-DCE | $0 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $0 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $16,000 |
| OTVD for Very low flashpoint (<0C) solvent | $16,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $70,000 |
| Co-Solvent, Bi-Solvent | $22,000 |
| Semi-Aqueous | $10,000 |
| Replace with Aqueous Cleaning | $3,333 |
| Hybrid system (e.g., Inventec, HEMO) | $39,200 |
| Medium/High Precision Cleaning | Replace with Airless Degreaser with PCE | $28,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $18,000 |
| Replace with OTVD using Flashpoint inerted t-DCE | $9,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $0 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $16,000 |
| OTVD for Very low flashpoint (<0C) solvent | $36,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $35,000 |
| Co-Solvent, Bi-Solvent | $22,000 |
| Semi-Aqueous | $10,000 |
| Replace with Aqueous Cleaning | $3,333 |
| Hybrid system (e.g., Inventec, HEMO) | $39,200 |
| Large/High Precision Cleaning | Replace with Airless Degreaser with PCE | $28,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $9,000 |
| Replace with OTVD using Flashpoint inerted t-DCE | $9,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $0 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $16,000 |
| OTVD for Very low flashpoint (<0C) solvent | $16,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $35,000 |
| Co-Solvent, Bi-Solvent | $22,000 |
| Semi-Aqueous | $10,000 |
| Replace with Aqueous Cleaning | $3,333 |
| Hybrid system (e.g., Inventec, HEMO) | $39,200 |
| Small/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $28,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $9,000 |
| Replace with OTVD using Flashpoint inerted t-DCE | $9,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $0 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $16,000 |
| OTVD for Very low flashpoint (<0C) solvent | $16,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $35,000 |
| Co-Solvent, Bi-Solvent | $22,000 |
| Semi-Aqueous | $10,000 |
| Replace with Aqueous Cleaning | $3,333 |
| Hybrid system (e.g., Inventec, HEMO) | $39,200 |
| Medium/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $28,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $9,000 |
| Replace with OTVD using Flashpoint inerted t-DCE | $9,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $0 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $16,000 |
| OTVD for Very low flashpoint (<0C) solvent | $16,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $35,000 |
| Co-Solvent, Bi-Solvent | $22,000 |
| Semi-Aqueous | $10,000 |
| Replace with Aqueous Cleaning | $3,333 |
| Hybrid system (e.g., Inventec, HEMO) | $39,200 |
| Large/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $28,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $9,000 |
| Replace with OTVD using Flashpoint inerted t-DCE | $9,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $0 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $16,000 |
| OTVD for Very low flashpoint (<0C) solvent | $16,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $35,000 |
| Co-Solvent, Bi-Solvent | $22,000 |
| Semi-Aqueous | $10,000 |
| Replace with Aqueous Cleaning | $3,333 |
| Hybrid system (e.g., Inventec, HEMO) | $39,200 |
| Small/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | $28,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $18,000 |
| Replace with OTVD using Flashpoint inerted t-DCE | $9,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $0 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $16,000 |
| OTVD for Very low flashpoint (<0C) solvent | $16,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $35,000 |
| Co-Solvent, Bi-Solvent | $22,000 |
| Semi-Aqueous | $10,000 |
| Replace with Aqueous Cleaning | $3,333 |
| Medium/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | $28,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $18,000 |
| Replace with OTVD using Flashpoint inerted t-DCE | $9,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $0 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $16,000 |
| OTVD for Very low flashpoint (<0C) solvent | $16,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $35,000 |
| Co-Solvent, Bi-Solvent | $22,000 |
| Semi-Aqueous | $10,000 |
| Replace with Aqueous Cleaning | $3,333 |

### Cleaning Agent Costs

The initial fill for the cleaning agent matches the volume of the tank, which is the correct volume if full immersion cleaning is used. This may overstate the initial fill if the entire chamber is not filled. Some vapor degreasers, including airless, may clean only in vapor zone, or by spray wand, and will only be filled to a fraction of the chamber size. This will reduce the amount of solvent needed to be purchased. General cleaning applications are more likely to need full immersion due to higher soil loading.

Annual fill cleaning agent estimates account for several different factors, including the type of soil, cleanliness requirements, loss of cleaning agent, and soil loading. Aqueous tanks need to be changed more frequently than solvent and thus will have a high annual replacement; general cleaning will have a higher soil load and will need even more frequent changes. BFK Solutions’ estimates for the annual fill volumes of solvents were informed by various sources of real-world application and SAFECHEM estimates.

Table 7‑18 presents the estimated initial fill costs for cleaning agent. These initial costs range from $120 to $240,000.

| Table 7‑18: Cleaning Agent Costs: Initial Fill by Size, Cleaning Category, and Alternative Cleaning Method | | |
| --- | --- | --- |
| Size/Cleaning Category | Alternative Cleaning Method | Estimated Initial Costs (2022$) |
| Small/General Cleaning | Replace with Airless Degreaser with PCE | $900 |
| Convert OTVD to use Flashpoint inerted t-DCE | $1,800 |
| Replace with OTVD using Flashpoint inerted t-DCE | $1,800 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $1,800 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $240 |
| OTVD for Very low flashpoint (<0C) solvent | $300 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $180 |
| Co-Solvent, Bi-Solvent | $1,911 |
| High boiling, non-vacuum, non-rinse | $360 |
| Semi-Aqueous | $348 |
| Replace with Aqueous Cleaning | $120 |
| Hybrid system (e.g., Inventec, HEMO) | $3,600 |
| Medium/General Cleaning | Replace with Airless Degreaser with PCE | $18,750 |
| Convert OTVD to use Flashpoint inerted t-DCE | $37,500 |
| Replace with OTVD using Flashpoint inerted t-DCE | $37,500 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $37,500 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $5,000 |
| OTVD for Very low flashpoint (<0C) solvent | $6,250 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $3,750 |
| Co-Solvent, Bi-Solvent | $39,813 |
| High boiling, non-vacuum, non-rinse | $7,500 |
| Semi-Aqueous | $7,250 |
| Replace with Aqueous Cleaning | $2,500 |
| Hybrid system (example: Inventec, HEMO) | $75,000 |
| Large/General Cleaning | Replace with Airless Degreaser with PCE | $60,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $120,000 |
| Replace with OTVD using FlashPoint inerted t-DCE | $120,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $120,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $16,000 |
| OTVD for Very low flashpoint (<0C) solvent | $20,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $12,000 |
| Co-Solvent, Bi-Solvent | $127,400 |
| High boiling, non-vacuum, non-rinse | $24,000 |
| Semi-Aqueous | $23,200 |
| Replace with Aqueous Cleaning | $8,000 |
| Hybrid system (example: Inventec, HEMO) | $240,000 |
| Small/High Precision Cleaning | Replace with Airless Degreaser with PCE | $900 |
| Convert OTVD to use Flashpoint inerted t-DCE | $1,800 |
| Replace with OTVD using FlashPoint inerted t-DCE | $1,800 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $1,800 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $240 |
| OTVD for Very low flashpoint (<0C) solvent | $300 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $180 |
| Co-Solvent, Bi-Solvent | $1,911 |
| Semi-Aqueous | $348 |
| Replace with Aqueous Cleaning | $120 |
| Hybrid system (example: Inventec, HEMO) | $3,600 |
| Medium/High Precision Cleaning | Replace with Airless Degreaser with PCE | $18,750 |
| Convert OTVD to use Flashpoint inerted t-DCE | $37,500 |
| Replace with OTVD using FlashPoint inerted t-DCE | $37,500 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $37,500 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $5,000 |
| OTVD for Very low flashpoint (<0C) solvent | $6,250 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $3,750 |
| Co-Solvent, Bi-Solvent | $39,813 |
| Semi-Aqueous | $7,250 |
| Replace with Aqueous Cleaning | $2,500 |
| Hybrid system (example: Inventec, HEMO) | $75,000 |
| Large/High Precision Cleaning | Replace with Airless Degreaser with PCE | $60,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $120,000 |
| Replace with OTVD using FlashPoint inerted t-DCE | $120,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $120,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $16,000 |
| OTVD for Very low flashpoint (<0C) solvent | $20,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $12,000 |
| Co-Solvent, Bi-Solvent | $127,400 |
| Semi-Aqueous | $23,200 |
| Replace with Aqueous Cleaning | $8,000 |
| Hybrid system (example: Inventec, HEMO) | $240,000 |
| Small/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $900 |
| Convert OTVD to use Flashpoint inerted t-DCE | $1,800 |
| Replace with OTVD using FlashPoint inerted t-DCE | $1,800 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $1,800 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $240 |
| OTVD for Very low flashpoint (<0C) solvent | $300 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $180 |
| Co-Solvent, Bi-Solvent | $1,911 |
| Semi-Aqueous | $348 |
| Replace with Aqueous Cleaning | $120 |
| Hybrid system (example: Inventec, HEMO) | $3,600 |
| Medium/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $18,750 |
| Convert OTVD to use Flashpoint inerted t-DCE | $37,500 |
| Replace with OTVD using FlashPoint inerted t-DCE | $37,500 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $37,500 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $5,000 |
| OTVD for Very low flashpoint (<0C) solvent | $6,250 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $3,750 |
| Co-Solvent, Bi-Solvent | $39,813 |
| Semi-Aqueous | $7,250 |
| Replace with Aqueous Cleaning | $2,500 |
| Hybrid system (example: Inventec, HEMO) | $75,000 |
| Large/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $60,000 |
| Convert OTVD to use Flashpoint inerted t-DCE | $120,000 |
| Replace with OTVD using FlashPoint inerted t-DCE | $120,000 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $120,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $16,000 |
| OTVD for Very low flashpoint (<0C) solvent | $20,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $12,000 |
| Co-Solvent, Bi-Solvent | $127,400 |
| Semi-Aqueous | $23,200 |
| Replace with Aqueous Cleaning | $8,000 |
| Hybrid system (example: Inventec, HEMO) | $240,000 |
| Small/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | $900 |
| Convert OTVD to use Flashpoint inerted t-DCE | $1,800 |
| Replace with OTVD using FlashPoint inerted t-DCE | $1,800 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $1,800 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $240 |
| OTVD for Very low flashpoint (<0C) solvent | $300 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $180 |
| Co-Solvent, Bi-Solvent | $1,911 |
| Semi-Aqueous | $348 |
| Replace with Aqueous Cleaning | $120 |
| Medium/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | $18,750 |
| Convert OTVD to use Flashpoint inerted t-DCE | $37,500 |
| Replace with OTVD using FlashPoint inerted t-DCE | $37,500 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $37,500 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $5,000 |
| OTVD for Very low flashpoint (<0C) solvent | $6,250 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $3,750 |
| Co-Solvent, Bi-Solvent | $39,813 |
| Semi-Aqueous | $7,250 |
| Replace with Aqueous Cleaning | $2,500 |

Table 7‑19 presents the cleaning estimated baseline annual replacement cleaning agent costs.

| Table 7‑19: Cleaning Agent Costs: Cleaning Agent Costs: Baseline Annual Replacement (2022$) | | | | |
| --- | --- | --- | --- | --- |
| Size/Cleaning Category | Cleaning Chamber Tank Size in Inches (Approx) | Cleaning Agent; Annual Replacement (gal) | Cleaning Agent Price ($/gal) | Baseline Cost |
| Small/General Cleaning | 12 x 12 x 10 | 36 | $150 | $5,400 |
| Medium/General Cleaning | 36 x 36 x 22 | 726 | $150 | $108,900 |
| Large/General Cleaning | 60 x 42 x 36 | 1,162 | $300 | $348,450 |
| Small/High Precision Cleaning | 12 x 12 x 10 | 16 | $300 | $4,860 |
| Medium/High Precision Cleaning | 36 x 36 x 22 | 330 | $300 | $99,000 |
| Large/High Precision Cleaning | 60 x 42 x 36 | 8,711 | $40 | $348,450 |
| Small/Safety Critical Cleaning | 12 x 12 x 10 | 97 | $50 | $4,860 |
| Medium/Safety Critical Cleaning | 36 x 36 x 22 | 3,300 | $30 | $99,000 |
| Large/Safety Critical Cleaning | 60 x 42 x 36 | 2,188 | $159 | $348,450 |
| Small/Start-Up/R&D Critical Cleaning | 12 x 12 x 10 | 81 | $60 | $4,860 |
| Medium/Start-Up/R&D Critical Cleaning | 36 x 36 x 22 | 28 | $58 | $1,620 |

Table 7‑20 presents the incremental annual cleaning agent replacement costs, which range from a cost savings of about $350,000 (indicated as a negative incremental cost) to an increased cost of about $1 million annually.

| Table 7‑20: Cleaning Agent Costs by Size, Cleaning Category, and Alternative Cleaning Method: Annual Replacement (2022$) | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Size/Cleaning Category | Alternative Cleaning Method | Cleaning Agent; Annual Replacement (gal) | Cleaning Agent Price ($/gal) | Baseline Cost | Post-Conversion Cost | Incremental Cost |
| Small/General Cleaning | Replace with Airless Degreaser with PCE | 12 | $150 | $5,400 | $1,800 | ($3,600) |
| Convert OTVD to use Flashpoint inerted t-DCE | 45 | $300 | $5,400 | $13,500 | $8,100 |
| Replace with OTVD using FlashPoint inerted t-DCE | 45 | $300 | $5,400 | $13,500 | $8,100 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 36 | $300 | $5,400 | $10,800 | $5,400 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 45 | $40 | $5,400 | $1,800 | ($3,600) |
| OTVD for Very low flashpoint (<0C) solvent | 45 | $50 | $5,400 | $2,250 | ($3,150) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 12 | $30 | $5,400 | $360 | ($5,040) |
| Co-Solvent, Bi-Solvent | 48 | $159 | $5,400 | $7,644 | $2,244 |
| High boiling, non-vacuum, non-rinse | 45 | $60 | $5,400 | $2,700 | ($2,700) |
| Semi-Aqueous | 12 | $58 | $5,400 | $696 | ($4,704) |
| Replace with Aqueous Cleaning | 144 | $20 | $5,400 | $2,880 | ($2,520) |
| Hybrid system (example: Inventec, HEMO) | 12 | $300 | $5,400 | $3,600 | ($1,800) |
| Medium/General Cleaning | Replace with Airless Degreaser with PCE | 55 | $150 | $108,900 | $8,250 | ($100,650) |
| Convert OTVD to use Flashpoint inerted t-DCE | 908 | $300 | $108,900 | $272,400 | $163,500 |
| Replace with OTVD using FlashPoint inerted t-DCE | 908 | $300 | $108,900 | $272,250 | $163,350 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 726 | $300 | $108,900 | $217,800 | $108,900 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 908 | $40 | $108,900 | $36,320 | ($72,580) |
| OTVD for Very low flashpoint (<0C) solvent | 908 | $50 | $108,900 | $45,400 | ($63,500) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 330 | $30 | $108,900 | $9,900 | ($99,000) |
| Co-Solvent, Bi-Solvent | 750 | $159 | $108,900 | $119,438 | $10,538 |
| High boiling, non-vacuum, non-rinse | 908 | $60 | $108,900 | $54,480 | ($54,420) |
| Semi-Aqueous | 908 | $58 | $108,900 | $52,664 | ($56,236) |
| Replace with Aqueous Cleaning | 1,500 | $20 | $108,900 | $30,000 | ($78,900) |
| Hybrid system (example: Inventec, HEMO) | 660 | $300 | $108,900 | $198,000 | $89,100 |
| Large/General Cleaning | Replace with Airless Degreaser with PCE | 300 | $150 | $348,450 | $45,000 | ($303,450) |
| Convert OTVD to use Flashpoint inerted t-DCE | 2,323 | $300 | $348,450 | $696,900 | $348,450 |
| Replace with OTVD using FlashPoint inerted t-DCE | 2,904 | $300 | $348,450 | $871,125 | $522,675 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 2,323 | $300 | $348,450 | $696,900 | $348,450 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 2,323 | $40 | $348,450 | $92,920 | ($255,530) |
| OTVD for Very low flashpoint (<0C) solvent | 2,323 | $50 | $348,450 | $116,150 | ($232,300) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 100 | $30 | $348,450 | $3,000 | ($345,450) |
| Co-Solvent, Bi-Solvent | 2,400 | $159 | $348,450 | $382,200 | $33,750 |
| High boiling, non-vacuum, non-rinse | 2,323 | $60 | $348,450 | $139,380 | ($209,070) |
| Semi-Aqueous | 2,323 | $58 | $348,450 | $134,734 | ($213,716) |
| Replace with Aqueous Cleaning | 4,800 | $20 | $348,450 | $96,000 | ($252,450) |
| Hybrid system (example: Inventec, HEMO) | 200 | $300 | $348,450 | $60,000 | ($288,450) |
| Small/High Precision Cleaning | Replace with Airless Degreaser with PCE | 11 | $150 | $4,860 | $1,620 | ($3,240) |
| Convert OTVD to use Flashpoint inerted t-DCE | 41 | $300 | $4,860 | $12,150 | $7,290 |
| Replace with OTVD using FlashPoint inerted t-DCE | 41 | $300 | $4,860 | $12,150 | $7,290 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 32 | $300 | $4,860 | $9,720 | $4,860 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 41 | $40 | $4,860 | $1,620 | ($3,240) |
| OTVD for Very low flashpoint (<0C) solvent | 41 | $50 | $4,860 | $2,025 | ($2,835) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 11 | $30 | $4,860 | $324 | ($4,536) |
| Co-Solvent, Bi-Solvent | 43 | $159 | $4,860 | $6,880 | $2,020 |
| Semi-Aqueous | 11 | $58 | $4,860 | $626 | ($4,234) |
| Replace with Aqueous Cleaning | 130 | $20 | $4,860 | $2,592 | ($2,268) |
| Hybrid system (example: Inventec, HEMO) | 11 | $300 | $4,860 | $3,240 | ($1,620) |
| Medium/High Precision Cleaning | Replace with Airless Degreaser with PCE | 55 | $150 | $99,000 | $8,250 | ($90,750) |
| Convert OTVD to use Flashpoint inerted t-DCE | 825 | $300 | $99,000 | $247,500 | $148,500 |
| Replace with OTVD using FlashPoint inerted t-DCE | 825 | $300 | $99,000 | $247,500 | $148,500 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 660 | $300 | $99,000 | $198,000 | $99,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 825 | $40 | $99,000 | $33,000 | ($66,000) |
| OTVD for Very low flashpoint (<0C) solvent | 825 | $50 | $99,000 | $41,250 | ($57,750) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 55 | $30 | $99,000 | $1,650 | ($97,350) |
| Co-Solvent, Bi-Solvent | 825 | $159 | $99,000 | $131,381 | $32,381 |
| Semi-Aqueous | 825 | $58 | $99,000 | $47,850 | ($51,150) |
| Replace with Aqueous Cleaning | 375 | $20 | $99,000 | $7,500 | ($91,500) |
| Hybrid system (example: Inventec, HEMO) | 660 | $300 | $99,000 | $198,000 | $99,000 |
| Large/High Precision Cleaning | Replace with Airless Degreaser with PCE | 300 | $150 | $348,450 | $45,000 | ($303,450) |
| Convert OTVD to use Flashpoint inerted t-DCE | 2,323 | $300 | $348,450 | $696,900 | $348,450 |
| Replace with OTVD using FlashPoint inerted t-DCE | 2,323 | $300 | $348,450 | $696,900 | $348,450 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 2,323 | $300 | $348,450 | $696,900 | $348,450 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 2,323 | $40 | $348,450 | $92,920 | ($255,530) |
| OTVD for Very low flashpoint (<0C) solvent | 2,323 | $50 | $348,450 | $116,150 | ($232,300) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 2,323 | $30 | $348,450 | $69,690 | ($278,760) |
| Co-Solvent, Bi-Solvent | 100 | $159 | $348,450 | $15,925 | ($332,525) |
| Semi-Aqueous | 2,323 | $58 | $348,450 | $134,734 | ($213,716) |
| Replace with Aqueous Cleaning | 2,323 | $20 | $348,450 | $46,460 | ($301,990) |
| Hybrid system (example: Inventec, HEMO) | 4,800 | $300 | $348,450 | $1,440,000 | $1,091,550 |
| Small/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | 11 | $150 | $4,860 | $1,620 | ($3,240) |
| Convert OTVD to use Flashpoint inerted t-DCE | 41 | $300 | $4,860 | $12,150 | $7,290 |
| Replace with OTVD using FlashPoint inerted t-DCE | 41 | $300 | $4,860 | $12,150 | $7,290 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 32 | $300 | $4,860 | $9,720 | $4,860 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 41 | $40 | $4,860 | $1,620 | ($3,240) |
| OTVD for Very low flashpoint (<0C) solvent | 41 | $50 | $4,860 | $2,025 | ($2,835) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 11 | $30 | $4,860 | $324 | ($4,536) |
| Co-Solvent, Bi-Solvent | 43 | $159 | $4,860 | $6,880 | $2,020 |
| Semi-Aqueous | 11 | $58 | $4,860 | $626 | ($4,234) |
| Replace with Aqueous Cleaning | 130 | $20 | $4,860 | $2,592 | ($2,268) |
| Hybrid system (example: Inventec, HEMO) | 11 | $300 | $4,860 | $3,240 | ($1,620) |
| Medium/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | 55 | $150 | $99,000 | $8,250 | ($90,750) |
| Convert OTVD to use Flashpoint inerted t-DCE | 55 | $300 | $99,000 | $16,500 | ($82,500) |
| Replace with OTVD using FlashPoint inerted t-DCE | 825 | $300 | $99,000 | $247,500 | $148,500 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 660 | $300 | $99,000 | $198,000 | $99,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 825 | $40 | $99,000 | $33,000 | ($66,000) |
| OTVD for Very low flashpoint (<0C) solvent | 825 | $50 | $99,000 | $41,250 | ($57,750) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 825 | $30 | $99,000 | $24,750 | ($74,250) |
| Co-Solvent, Bi-Solvent | 55 | $159 | $99,000 | $8,759 | ($90,241) |
| Semi-Aqueous | 825 | $58 | $99,000 | $47,850 | ($51,150) |
| Replace with Aqueous Cleaning | 825 | $20 | $99,000 | $16,500 | ($82,500) |
| Hybrid system (e.g., Inventec, HEMO) | 375 | $300 | $99,000 | $112,500 | $13,500 |
| Large/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | 300 | $150 | $348,450 | $45,000 | ($303,450) |
| Convert OTVD to use Flashpoint inerted t-DCE | 2,323 | $300 | $348,450 | $696,900 | $348,450 |
| Replace with OTVD using Flashpoint inerted t-DCE | 2,323 | $300 | $348,450 | $696,900 | $348,450 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 2,323 | $300 | $348,450 | $696,900 | $348,450 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 2,323 | $40 | $348,450 | $92,920 | ($255,530) |
| OTVD for Very low flashpoint (<0C) solvent | 2,323 | $50 | $348,450 | $116,150 | ($232,300) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 2,323 | $30 | $348,450 | $69,690 | ($278,760) |
| Co-Solvent, Bi-Solvent | 100 | $159 | $348,450 | $15,925 | ($332,525) |
| Semi-Aqueous | 2,323 | $58 | $348,450 | $134,734 | ($213,716) |
| Replace with Aqueous Cleaning | 2,323 | $20 | $348,450 | $46,460 | ($301,990) |
| Hybrid system (e.g., Inventec, HEMO) | 4,800 | $300 | $348,450 | $1,440,000 | $1,091,550 |
| Small/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | 11 | $150 | $4,860 | $1,620 | ($3,240) |
| Convert OTVD to use Flashpoint inerted t-DCE | 41 | $300 | $4,860 | $12,150 | $7,290 |
| Replace with OTVD using Flashpoint inerted t-DCE | 41 | $300 | $4,860 | $12,150 | $7,290 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 32 | $300 | $4,860 | $9,720 | $4,860 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 41 | $40 | $4,860 | $1,620 | ($3,240) |
| OTVD for Very low flashpoint (<0C) solvent | 41 | $50 | $4,860 | $2,025 | ($2,835) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 11 | $30 | $4,860 | $324 | ($4,536) |
| Co-Solvent, Bi-Solvent | 43 | $159 | $4,860 | $6,880 | $2,020 |
| Semi-Aqueous | 11 | $58 | $4,860 | $626 | ($4,234) |
| Replace with Aqueous Cleaning | 130 | $20 | $4,860 | $2,592 | ($2,268) |
| Medium/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | 55 | $150 | $1,620 | $8,250 | $6,630 |
| Convert OTVD to use Flashpoint inerted t-DCE | 55 | $300 | $1,620 | $16,500 | $14,880 |
| Replace with OTVD using Flashpoint inerted t-DCE | 825 | $300 | $1,620 | $247,500 | $245,880 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 11 | $300 | $1,620 | $3,240 | $1,620 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 825 | $40 | $1,620 | $33,000 | $31,380 |
| OTVD for Very low flashpoint (<0C) solvent | 825 | $50 | $1,620 | $41,250 | $39,630 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 825 | $30 | $1,620 | $24,750 | $23,130 |
| Co-Solvent, Bi-Solvent | 55 | $159 | $1,620 | $8,759 | $7,139 |
| Semi-Aqueous | 825 | $58 | $1,620 | $47,850 | $46,230 |
| Replace with Aqueous Cleaning | 825 | $20 | $1,620 | $16,500 | $14,880 |

### Waste Disposal Costs

Disposal costs were estimated based on methylene chloride disposal costs and adjusted based on cleaning agent and method. For example, there is an estimated 20 percent upcharge for fluorinated solvents compared to methylene chloride. Additionally, if the cleaning agent is combustible than it would be 80 percent of the methylene chloride cost.

Table 7‑21 presents the baseline waste disposal costs for methylene chloride vapor degreasing.

Table 7‑22 presents the estimated annual waste disposal costs under the baseline, under the new cleaning method, and the incremental change in the annual waste disposal costs. These costs range from a savings of about $4,000 (indicated as a negative incremental cost) to $16,000 in additional waste disposal costs.

| Table 7‑21: Baseline Waste Disposal Costs by Size and Cleaning Category (2022$) | | | |
| --- | --- | --- | --- |
| Size/Cleaning Category | Cleaning Agent; Annual Replacement (gal) | Cleaning Agent Price ($/gal) | Baseline Cost |
| Small/General Cleaning | 17 | $18.20 | $309 |
| Medium/General Cleaning | 330 | $6,006 |
| Large/General Cleaning | 1,056 | $19,219 |
| Small/High Precision Cleaning | 6 | $100 |
| Medium/High Precision Cleaning | 110 | $2,002 |
| Large/High Precision Cleaning | 352 | $6,406 |
| Small/Safety Critical Cleaning | 6 | $100 |
| Medium/Safety Critical Cleaning | 110 | $2,002 |
| Large/Safety Critical Cleaning | 352 | $6,406 |
| Small/Start-Up/R&D Critical Cleaning | 6 | $100 |
| Medium/Start-Up/R&D Critical Cleaning | 110 | $2,002 |

| Table 7‑22: Annual Waste Disposal Costs, by Size, Cleaning Category and Alternative Cleaning Method (2022$) | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Size/Cleaning Category | Alternative Cleaning Method | Liquid Waste (gal) | Disposal Cost ($/gal) | Baseline Cost | Post-Conversion Cost | Incremental Cost  Incremental Cost |
| Small/General Cleaning | Replace with Airless Degreaser with PCE | 17 | $18.20 | $309 | $309 | $0 |
| Convert OTVD to use Flashpoint inerted t-DCE | 17 | $21.80 | $309 | $371 | $61 |
| Replace with OTVD using Flashpoint inerted t-DCE | 17 | $21.80 | $309 | $371 | $61 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 17 | $21.80 | $309 | $371 | $61 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 17 | $14.50 | $309 | $247 | ($63) |
| OTVD for Very low flashpoint (<0C) solvent | 17 | $14.50 | $309 | $247 | ($63) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 17 | $14.50 | $309 | $247 | ($63) |
| Co-Solvent, Bi-Solvent | 17 | $14.50 | $309 | $247 | ($63) |
| High boiling, non-vacuum, non-rinse | 17 | $14.50 | $309 | $247 | ($63) |
| Semi-Aqueous | 17 | $14.50 | $309 | $247 | ($63) |
| Replace with Aqueous Cleaning | 72 | $4.00 | $309 | $288 | ($21) |
| Hybrid system (e.g., Inventec, HEMO) | 17 | $14.50 | $309 | $247 | ($63) |
| Medium/General Cleaning | Replace with Airless Degreaser with PCE | 330 | $18.20 | $6,006 | $6,006 | $0 |
| Convert OTVD to use Flashpoint inerted t-DCE | 330 | $21.80 | $6,006 | $7,194 | $1,188 |
| Replace with OTVD using Flashpoint inerted t-DCE | 330 | $21.80 | $6,006 | $7,194 | $1,188 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 330 | $21.80 | $6,006 | $7,194 | $1,188 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 330 | $14.50 | $6,006 | $4,785 | ($1,221) |
| OTVD for Very low flashpoint (<0C) solvent | 330 | $14.50 | $6,006 | $4,785 | ($1,221) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 330 | $14.50 | $6,006 | $4,785 | ($1,221) |
| Co-Solvent, Bi-Solvent | 330 | $14.50 | $6,006 | $4,785 | ($1,221) |
| High boiling, non-vacuum, non-rinse | 330 | $14.50 | $6,006 | $4,785 | ($1,221) |
| Semi-Aqueous | 330 | $14.50 | $6,006 | $4,785 | ($1,221) |
| Replace with Aqueous Cleaning | 1,500 | $4.00 | $6,006 | $6,000 | ($6) |
| Hybrid system (e.g., Inventec, HEMO) | 330 | $14.50 | $6,006 | $4,785 | ($1,221) |
| Large/General Cleaning | Replace with Airless Degreaser with PCE | 1,056 | $18.20 | $19,219 | $19,219 | $0 |
| Convert OTVD to use Flashpoint inerted t-DCE | 1,056 | $21.80 | $19,219 | $23,021 | $3,802 |
| Replace with OTVD using Flashpoint inerted t-DCE | 1,056 | $21.80 | $19,219 | $23,021 | $3,802 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 1,056 | $21.80 | $19,219 | $23,021 | $3,802 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 1,056 | $14.50 | $19,219 | $15,312 | ($3,907) |
| OTVD for Very low flashpoint (<0C) solvent | 1,056 | $14.50 | $19,219 | $15,312 | ($3,907) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 1,056 | $14.50 | $19,219 | $15,312 | ($3,907) |
| Co-Solvent, Bi-Solvent | 1,056 | $14.50 | $19,219 | $15,312 | ($3,907) |
| High boiling, non-vacuum, non-rinse | 1,056 | $14.50 | $19,219 | $15,312 | ($3,907) |
| Semi-Aqueous | 1,056 | $14.50 | $19,219 | $15,312 | ($3,907) |
| Replace with Aqueous Cleaning | 4,800 | $4.00 | $19,219 | $19,200 | ($19) |
| Hybrid system (e.g., Inventec, HEMO) | 2,112 | $14.50 | $19,219 | $30,624 | $11,405 |
| Small/High Precision Cleaning | Replace with Airless Degreaser with PCE | 3 | $18.20 | $100 | $55 | ($46) |
| Convert OTVD to use Flashpoint inerted t-DCE | 8 | $21.80 | $100 | $174 | $74 |
| Replace with OTVD using Flashpoint inerted t-DCE | 8 | $21.80 | $100 | $174 | $74 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 6 | $21.80 | $100 | $120 | $20 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 8 | $14.50 | $100 | $116 | $16 |
| OTVD for Very low flashpoint (<0C) solvent | 8 | $14.50 | $100 | $116 | $16 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 3 | $14.50 | $100 | $44 | ($57) |
| Co-Solvent, Bi-Solvent | 8 | $14.50 | $100 | $116 | $16 |
| Semi-Aqueous | 8 | $14.50 | $100 | $116 | $16 |
| Replace with Aqueous Cleaning | 18 | $4.00 | $100 | $72 | ($28) |
| Hybrid system (e.g., Inventec, HEMO) | 17 | $8.20 | $100 | $139 | $39 |
| Medium/High Precision Cleaning | Replace with Airless Degreaser with PCE | 110 | $18.20 | $2,002 | $2,002 | $0 |
| Convert OTVD to use Flashpoint inerted t-DCE | 110 | $21.80 | $2,002 | $2,398 | $396 |
| Replace with OTVD using Flashpoint inerted t-DCE | 110 | $21.80 | $2,002 | $2,398 | $396 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 110 | $21.80 | $2,002 | $2,398 | $396 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 110 | $14.50 | $2,002 | $1,595 | ($407) |
| OTVD for Very low flashpoint (<0C) solvent | 110 | $14.50 | $2,002 | $1,595 | ($407) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 110 | $14.50 | $2,002 | $1,595 | ($407) |
| Co-Solvent, Bi-Solvent | 110 | $14.50 | $2,002 | $1,595 | ($407) |
| Semi-Aqueous | 110 | $14.50 | $2,002 | $1,595 | ($407) |
| Replace with Aqueous Cleaning | 940 | $4.00 | $2,002 | $3,760 | $1,758 |
| Hybrid system (e.g., Inventec, HEMO) | 330 | $14.50 | $2,002 | $4,785 | $2,783 |
| Large/High Precision Cleaning | Replace with Airless Degreaser with PCE | 400 | $18.20 | $6,406 | $7,280 | $874 |
| Convert OTVD to use Flashpoint inerted t-DCE | 352 | $21.80 | $6,406 | $7,674 | $1,267 |
| Replace with OTVD using Flashpoint inerted t-DCE | 352 | $21.80 | $6,406 | $7,674 | $1,267 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 352 | $21.80 | $6,406 | $7,674 | $1,267 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 352 | $14.50 | $6,406 | $5,104 | ($1,302) |
| OTVD for Very low flashpoint (<0C) solvent | 352 | $14.50 | $6,406 | $5,104 | ($1,302) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 400 | $14.50 | $6,406 | $5,800 | ($606) |
| Co-Solvent, Bi-Solvent | 352 | $14.50 | $6,406 | $5,104 | ($1,302) |
| Semi-Aqueous | 352 | $14.50 | $6,406 | $5,104 | ($1,302) |
| Replace with Aqueous Cleaning | 5,500 | $4.00 | $6,406 | $22,000 | $15,594 |
| Hybrid system (e.g., Inventec, HEMO) | 2,112 | $8.20 | $6,406 | $17,318 | $10,912 |
| Small/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | 3 | $18.20 | $100 | $55 | ($46) |
| Convert OTVD to use Flashpoint inerted t-DCE | 6 | $21.80 | $100 | $120 | $20 |
| Replace with OTVD using Flashpoint inerted t-DCE | 8 | $21.80 | $100 | $174 | $74 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 6 | $21.80 | $100 | $120 | $20 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 6 | $14.50 | $100 | $80 | ($20) |
| OTVD for Very low flashpoint (<0C) solvent | 6 | $14.50 | $100 | $80 | ($20) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 3 | $14.50 | $100 | $44 | ($57) |
| Co-Solvent, Bi-Solvent | 6 | $14.50 | $100 | $80 | ($20) |
| Semi-Aqueous | 6 | $14.50 | $100 | $80 | ($20) |
| Replace with Aqueous Cleaning | 18 | $4.00 | $100 | $72 | ($28) |
| Hybrid system (e.g., Inventec, HEMO) | 17 | $8.20 | $100 | $139 | $39 |
| Medium/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | 110 | $18.20 | $2,002 | $2,002 | $0 |
| Convert OTVD to use Flashpoint inerted t-DCE | 110 | $21.80 | $2,002 | $2,398 | $396 |
| Replace with OTVD using Flashpoint inerted t-DCE | 110 | $21.80 | $2,002 | $2,398 | $396 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 110 | $21.80 | $2,002 | $2,398 | $396 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 110 | $14.50 | $2,002 | $1,595 | ($407) |
| OTVD for Very low flashpoint (<0C) solvent | 110 | $14.50 | $2,002 | $1,595 | ($407) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 110 | $14.50 | $2,002 | $1,595 | ($407) |
| Co-Solvent, Bi-Solvent | 110 | $14.50 | $2,002 | $1,595 | ($407) |
| Semi-Aqueous | 110 | $14.50 | $2,002 | $1,595 | ($407) |
| Replace with Aqueous Cleaning | 940 | $4.00 | $2,002 | $3,760 | $1,758 |
| Hybrid system (e.g., Inventec, HEMO) | 330 | $8.20 | $2,002 | $2,706 | $704 |
| Large/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | 400 | $18.20 | $6,406 | $7,280 | $874 |
| Convert OTVD to use Flashpoint inerted t-DCE | 352 | $21.80 | $6,406 | $7,674 | $1,267 |
| Replace with OTVD using Flashpoint inerted t-DCE | 352 | $21.80 | $6,406 | $7,674 | $1,267 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 352 | $21.80 | $6,406 | $7,674 | $1,267 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 352 | $14.50 | $6,406 | $5,104 | ($1,302) |
| OTVD for Very low flashpoint (<0C) solvent | 352 | $14.50 | $6,406 | $5,104 | ($1,302) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 400 | $14.50 | $6,406 | $5,800 | ($606) |
| Co-Solvent, Bi-Solvent | 352 | $14.50 | $6,406 | $5,104 | ($1,302) |
| Semi-Aqueous | 352 | $14.50 | $6,406 | $5,104 | ($1,302) |
| Replace with Aqueous Cleaning | 5,500 | $4.00 | $6,406 | $22,000 | $15,594 |
| Hybrid system (e.g., Inventec, HEMO) | 2,112 | $8.20 | $6,406 | $17,318 | $10,912 |
| Small/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | 3 | $18.20 | $100 | $55 | ($46) |
| Convert OTVD to use Flashpoint inerted t-DCE | 6 | $21.80 | $100 | $120 | $20 |
| Replace with OTVD using Flashpoint inerted t-DCE | 8 | $21.80 | $100 | $174 | $74 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 6 | $21.80 | $100 | $120 | $20 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 6 | $14.50 | $100 | $80 | ($20) |
| OTVD for Very low flashpoint (<0C) solvent | 6 | $14.50 | $100 | $80 | ($20) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 3 | $14.50 | $100 | $44 | ($57) |
| Co-Solvent, Bi-Solvent | 6 | $14.50 | $100 | $80 | ($20) |
| Semi-Aqueous | 6 | $14.50 | $100 | $80 | ($20) |
| Replace with Aqueous Cleaning | 18 | $4.00 | $100 | $72 | ($28) |
| Medium/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | 110 | $18.20 | $2,002 | $2,002 | $0 |
| Convert OTVD to use Flashpoint inerted t-DCE | 110 | $21.80 | $2,002 | $2,398 | $396 |
| Replace with OTVD using Flashpoint inerted t-DCE | 110 | $21.80 | $2,002 | $2,398 | $396 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 110 | $21.80 | $2,002 | $2,398 | $396 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 110 | $14.50 | $2,002 | $1,595 | ($407) |
| OTVD for Very low flashpoint (<0C) solvent | 110 | $14.50 | $2,002 | $1,595 | ($407) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 110 | $14.50 | $2,002 | $1,595 | ($407) |
| Co-Solvent, Bi-Solvent | 110 | $14.50 | $2,002 | $1,595 | ($407) |
| Semi-Aqueous | 110 | $14.50 | $2,002 | $1,595 | ($407) |
| Replace with Aqueous Cleaning | 940 | $4.00 | $2,002 | $3,760 | $1,758 |

### Annual Maintenance Costs

Maintenance costs are highly dependent on the type and age of the cleaning system. There is an estimated 10- or 20-year life for most systems and maintenance costs will be needed for items like filters, process monitoring, annual employee check-ups, monitoring for soil or water contamination. There is a 25 percent additional markup for extra items.

Table 7‑23 presents the estimated annual maintenance costs under the baseline, under the new cleaning method, and the incremental change in the annual maintenance costs. These costs range from a savings of about $200,000 (indicated as a negative incremental cost) to $200,000 in additional waste disposal costs.

| Table 7‑23: Annual Maintenance Costs, by Size, Cleaning Category, and Alternative Cleaning Method (2022$) | | | | |
| --- | --- | --- | --- | --- |
| Size/Cleaning Category | Alternative Cleaning Method | Baseline Cost | Post-Conversion Cost | Incremental Cost |
| Small/General Cleaning | Replace with Airless Degreaser with PCE | $3,750 | $19,250 | $15,500 |
| Convert OTVD to use Flashpoint inerted t-DCE | $3,750 | $4,313 | $563 |
| Replace with OTVD using FlashPoint inerted t-DCE | $3,750 | $4,313 | $563 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $3,750 | $6,750 | $3,000 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $3,750 | $11,000 | $7,250 |
| OTVD for Very low flashpoint (<0C) solvent | $3,750 | $12,000 | $8,250 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $3,750 | $21,875 | $18,125 |
| Co-Solvent, Bi-Solvent | $3,750 | $28,875 | $25,125 |
| High boiling, non-vacuum, non-rinse | $3,750 | $300 | ($3,450) |
| Semi-Aqueous | $3,750 | $6,875 | $3,125 |
| Replace with Aqueous Cleaning | $3,750 | $15,208 | $11,458 |
| Hybrid system (e.g., Inventec, HEMO) | $3,750 | $26,950 | $23,200 |
| Medium/General Cleaning | Replace with Airless Degreaser with PCE | $22,500 | $31,750 | $9,250 |
| Convert OTVD to use Flashpoint inerted t-DCE | $22,500 | $11,250 | ($11,250) |
| Replace with OTVD using Flashpoint inerted t-DCE | $22,500 | $23,750 | $1,250 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $22,500 | $33,750 | $11,250 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $22,500 | $31,250 | $8,750 |
| OTVD for Very low flashpoint (<0C) solvent | $22,500 | $31,250 | $8,750 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $22,500 | $37,500 | $15,000 |
| Co-Solvent, Bi-Solvent | $22,500 | $31,250 | $8,750 |
| High boiling, non-vacuum, non-rinse | $22,500 | $1,000 | ($21,500) |
| Semi-Aqueous | $22,500 | $25,625 | $3,125 |
| Replace with Aqueous Cleaning | $22,500 | $31,875 | $9,375 |
| Hybrid system (e.g., Inventec, HEMO) | $22,500 | $44,450 | $21,950 |
| Large/General Cleaning | Replace with Airless Degreaser with PCE | $225,000 | $301,750 | $76,750 |
| Convert OTVD to use Flashpoint inerted t-DCE | $225,000 | $225,563 | $563 |
| Replace with OTVD using Flashpoint inerted t-DCE | $225,000 | $225,563 | $563 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $225,000 | $337,500 | $112,500 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $225,000 | $301,000 | $76,000 |
| OTVD for Very low flashpoint (<0C) solvent | $225,000 | $301,000 | $76,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $225,000 | $375,000 | $150,000 |
| Co-Solvent, Bi-Solvent | $225,000 | $19,375 | ($205,625) |
| High boiling, non-vacuum, non-rinse | $225,000 | $2,025 | ($222,975) |
| Semi-Aqueous | $225,000 | $10,625 | ($214,375) |
| Replace with Aqueous Cleaning | $225,000 | $311,250 | $86,250 |
| Hybrid system (e.g., Inventec, HEMO) | $225,000 | $422,450 | $197,450 |
| Small/High Precision Cleaning | Replace with Airless Degreaser with PCE | $3,750 | $19,250 | $15,500 |
| Convert OTVD to use Flashpoint inerted t-DCE | $3,750 | $3,750 | $0 |
| Replace with OTVD using Flashpoint inerted t-DCE | $3,750 | $3,750 | $0 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $3,750 | $5,625 | $1,875 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $3,750 | $11,000 | $7,250 |
| OTVD for Very low flashpoint (<0C) solvent | $3,750 | $11,000 | $7,250 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $3,750 | $21,875 | $18,125 |
| Co-Solvent, Bi-Solvent | $3,750 | $15,125 | $11,375 |
| Semi-Aqueous | $3,750 | $6,875 | $3,125 |
| Replace with Aqueous Cleaning | $3,750 | $16,458 | $12,708 |
| Hybrid system (e.g., Inventec, HEMO) | $3,750 | $20,700 | $16,950 |
| Medium/High Precision Cleaning | Replace with Airless Degreaser with PCE | $22,500 | $31,750 | $9,250 |
| Convert OTVD to use Flashpoint inerted t-DCE | $22,500 | $23,063 | $563 |
| Replace with OTVD using Flashpoint inerted t-DCE | $22,500 | $23,063 | $563 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $22,500 | $33,750 | $11,250 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $22,500 | $32,250 | $9,750 |
| OTVD for Very low flashpoint (<0C) solvent | $22,500 | $5,375 | ($17,125) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $22,500 | $32,188 | $9,688 |
| Co-Solvent, Bi-Solvent | $22,500 | $31,375 | $8,875 |
| Semi-Aqueous | $22,500 | $25,625 | $3,125 |
| Replace with Aqueous Cleaning | $22,500 | $31,458 | $8,958 |
| Hybrid system (e.g., Inventec, HEMO) | $22,500 | $44,450 | $21,950 |
| Large/High Precision Cleaning | Replace with Airless Degreaser with PCE | $225,000 | $301,750 | $76,750 |
| Convert OTVD to use Flashpoint inerted t-DCE | $225,000 | $225,563 | $563 |
| Replace with OTVD using Flashpoint inerted t-DCE | $225,000 | $225,563 | $563 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $225,000 | $337,500 | $112,500 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $225,000 | $301,000 | $76,000 |
| OTVD for Very low flashpoint (<0C) solvent | $225,000 | $301,000 | $76,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $225,000 | $302,188 | $77,188 |
| Co-Solvent, Bi-Solvent | $225,000 | $1,875 | ($223,125) |
| Semi-Aqueous | $225,000 | $10,625 | ($214,375) |
| Replace with Aqueous Cleaning | $225,000 | $300,208 | $75,208 |
| Hybrid system (e.g., Inventec, HEMO) | $225,000 | $422,450 | $197,450 |
| Small/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $3,750 | $19,250 | $15,500 |
| Convert OTVD to use Flashpoint inerted t-DCE | $3,750 | $4,313 | $563 |
| Replace with OTVD using Flashpoint inerted t-DCE | $3,750 | $4,313 | $563 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $3,750 | $5,625 | $1,875 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $3,750 | $11,000 | $7,250 |
| OTVD for Very low flashpoint (<0C) solvent | $3,750 | $11,000 | $7,250 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $3,750 | $19,688 | $15,938 |
| Co-Solvent, Bi-Solvent | $3,750 | $15,125 | $11,375 |
| Semi-Aqueous | $3,750 | $6,875 | $3,125 |
| Replace with Aqueous Cleaning | $3,750 | $3,958 | $208 |
| Hybrid system (e.g., Inventec, HEMO) | $3,750 | $26,950 | $23,200 |
| Medium/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $22,500 | $31,750 | $9,250 |
| Convert OTVD to use Flashpoint inerted t-DCE | $22,500 | $9,563 | ($12,938) |
| Replace with OTVD using Flashpoint inerted t-DCE | $22,500 | $23,063 | $563 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $22,500 | $33,750 | $11,250 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $22,500 | $32,250 | $9,750 |
| OTVD for Very low flashpoint (<0C) solvent | $22,500 | $32,250 | $9,750 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $22,500 | $32,188 | $9,688 |
| Co-Solvent, Bi-Solvent | $22,500 | $31,375 | $8,875 |
| Semi-Aqueous | $22,500 | $25,625 | $3,125 |
| Replace with Aqueous Cleaning | $22,500 | $31,458 | $8,958 |
| Hybrid system (e.g., Inventec, HEMO) | $22,500 | $44,450 | $21,950 |
| Large/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $225,000 | $301,750 | $76,750 |
| Convert OTVD to use Flashpoint inerted t-DCE | $225,000 | $45,563 | ($179,438) |
| Replace with OTVD using Flashpoint inerted t-DCE | $225,000 | $225,563 | $563 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $225,000 | $337,500 | $112,500 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $225,000 | $301,000 | $76,000 |
| OTVD for Very low flashpoint (<0C) solvent | $225,000 | $301,000 | $76,000 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $225,000 | $302,188 | $77,188 |
| Co-Solvent, Bi-Solvent | $225,000 | $301,375 | $76,375 |
| Semi-Aqueous | $225,000 | $100,625 | ($124,375) |
| Replace with Aqueous Cleaning | $225,000 | $300,208 | $75,208 |
| Hybrid system (example: Inventec, HEMO) | $225,000 | $421,200 | $196,200 |
| Small/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | $3,750 | $19,250 | $15,500 |
| Convert OTVD to use Flashpoint inerted t-DCE | $3,750 | $4,313 | $563 |
| Replace with OTVD using FlashPoint inerted t-DCE | $3,750 | $4,313 | $563 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $3,750 | $5,625 | $1,875 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $3,750 | $11,000 | $7,250 |
| OTVD for Very low flashpoint (<0C) solvent | $3,750 | $11,000 | $7,250 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $3,750 | $19,688 | $15,938 |
| Co-Solvent, Bi-Solvent | $3,750 | $15,125 | $11,375 |
| Semi-Aqueous | $3,750 | $6,875 | $3,125 |
| Replace with Aqueous Cleaning | $3,750 | $3,958 | $208 |
| Medium/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | $22,500 | $31,750 | $9,250 |
| Convert OTVD to use Flashpoint inerted t-DCE | $22,500 | $45,563 | $23,063 |
| Replace with OTVD using Flashpoint inerted t-DCE | $22,500 | $45,563 | $23,063 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | $22,500 | $33,750 | $11,250 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | $22,500 | $32,250 | $9,750 |
| OTVD for Very low flashpoint (<0C) solvent | $22,500 | $32,250 | $9,750 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $22,500 | $32,188 | $9,688 |
| Co-Solvent, Bi-Solvent | $22,500 | $31,375 | $8,875 |
| Semi-Aqueous | $22,500 | $25,625 | $3,125 |
| Replace with Aqueous Cleaning | $22,500 | $31,458 | $8,958 |

### Annual Labor Costs

Labor costs are dependent on the type of machine, degree of automation and number of runs. Table 7‑24 presents the estimated baseline labor costs for operating a vapor degreasing machine.

| Table 7‑24: Baseline Labor Costs (2022$) Size and Cleaning Category | | |
| --- | --- | --- |
| Size/Cleaning Category | Annual Labor (hours) | Baseline Labor Cost |
| Small/General Cleaning | 979 | $59,876 |
| Medium/General Cleaning | 850 | $51,986 |
| Large/General Cleaning | 790 | $48,316 |
| Small/High Precision Cleaning | 880 | $53,821 |
| Medium/High Precision Cleaning | 750 | $45,870 |
| Large/High Precision Cleaning | 640 | $39,142 |
| Small/Safety Critical Cleaning | 879 | $53,760 |
| Medium/Safety Critical Cleaning | 750 | $45,870 |
| Large/Safety Critical Cleaning | 640 | $39,142 |
| Small/Start-Up/R&D Critical Cleaning | 720 | $44,035 |
| Medium/Start-Up/R&D Critical Cleaning | 720 | $44,035 |

For the cleaning types and methods estimated to have incremental differences in labor costs, Table 7‑25 presents the estimated annual labor costs under the baseline, under the new cleaning method, and the incremental change in the annual labor costs. Among those facilities with incremental cost changes, the costs range from a savings of about $30,000 (indicated as a negative incremental cost) to $15,000 in additional labor costs.

| Table 7‑25: Annual Labor Costs (2022$) | | | | |
| --- | --- | --- | --- | --- |
| Size/Cleaning Category | Alternative Cleaning Method | Baseline Cost | Post-Conversion Cost | Incremental Cost |
| Small/General Cleaning | EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $59,876 | $32,598 | ($27,277) |
| Replace with Aqueous Cleaning | $59,876 | $62,995 | $3,119 |
| Medium/General Cleaning | Replace with Airless Degreaser with PCE | $51,986 | $32,598 | ($19,388) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $51,986 | $32,598 | ($19,388) |
| Replace with Aqueous Cleaning | $51,986 | $59,019 | $7,033 |
| Large/General Cleaning | Replace with Airless Degreaser with PCE | $48,316 | $32,598 | ($15,718) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $48,316 | $32,598 | ($15,718) |
| Replace with Aqueous Cleaning | $48,316 | $59,019 | $10,703 |
| Small/High Precision Cleaning | Replace with Airless Degreaser with PCE | $53,821 | $32,598 | ($21,223) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $53,821 | $32,598 | ($21,223) |
| Medium/High Precision Cleaning | Replace with Airless Degreaser with PCE | $45,870 | $32,598 | ($13,272) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $45,870 | $32,598 | ($13,272) |
| Replace with Aqueous Cleaning | $45,870 | $49,845 | $3,975 |
| Large/High Precision Cleaning | Replace with Airless Degreaser with PCE | $39,142 | $32,598 | ($6,544) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $39,142 | $32,598 | ($6,544) |
| Replace with Aqueous Cleaning | $39,142 | $47,093 | $7,951 |
| Small/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $53,760 | $32,598 | ($21,161) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $53,760 | $32,598 | ($21,161) |
| Replace with Aqueous Cleaning | $53,760 | $59,019 | $5,260 |
| Medium/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $45,870 | $32,598 | ($13,272) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $45,870 | $32,598 | ($13,272) |
| Replace with Aqueous Cleaning | $45,870 | $49,845 | $3,975 |
| Large/Safety Critical Cleaning | EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $39,142 | $32,598 | ($6,544) |
| Replace with Aqueous Cleaning | $39,142 | $47,093 | $7,951 |
| Small/Start-Up/R&D Critical Cleaning | EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $44,035 | $32,598 | ($11,437) |
| Replace with Aqueous Cleaning | $44,035 | $59,019 | $14,984 |
| Medium/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | $44,035 | $32,598 | ($11,437) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $44,035 | $32,598 | ($11,437) |
| Replace with Aqueous Cleaning | $44,035 | $49,845 | $5,810 |
| Small/Start-Up/R&D Critical Cleaning | Replace with Aqueous Cleaning | $44,035 | $59,019 | $14,984 |
| Medium/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | $44,035 | $32,598 | ($11,437) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $44,035 | $32,598 | ($11,437) |
| Replace with Aqueous Cleaning | $44,035 | $49,845 | $5,810 |

### Annual Electricity Costs

Electrical costs are assuming 2000 hours per work year (40hr/wk\*50wks). It is also assumed that this cost is dependent on the size of the cleaning system and is not dependent on the type of cleaning.

For the cleaning types and methods estimated to have incremental differences in electricity costs, Table 7‑26 presents the estimated annual electricity costs under the baseline, under the new cleaning method, and the incremental change in the annual costs. Among those facilities with incremental cost changes, the costs range from a savings of about $100 (indicated as a negative incremental cost) to $19,000 in additional electricity costs.

| Table 7‑26: Annual Electricity Costs by Size, Cleaning Category, and Alternative Cleaning Method (2022$) | | | | |
| --- | --- | --- | --- | --- |
| Size/Cleaning Category | Alternative Cleaning Method | Baseline Cost | Post-Conversion Cost | Incremental Cost |
| Small/General Cleaning | Replace with Airless Degreaser with PCE | $21 | $33 | $13 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $21 | $41 | $21 |
| High boiling, non-vacuum, non-rinse | $21 | $41 | $21 |
| Replace with Aqueous Cleaning | $21 | $483 | $463 |
| Hybrid system (e.g., Inventec, HEMO) | $21 | $162 | $142 |
| Medium/General Cleaning | Replace with Airless Degreaser with PCE | $259 | $419 | $160 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $259 | $518 | $259 |
| Co-Solvent, Bi-Solvent | $259 | $144 | ($115) |
| Semi-Aqueous | $259 | $1,723 | $1,464 |
| Replace with Aqueous Cleaning | $259 | $6,041 | $5,782 |
| Hybrid system (e.g., Inventec, HEMO) | $259 | $2,028 | $1,769 |
| Large/General Cleaning | Replace with Airless Degreaser with PCE | $828 | $1,339 | $511 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $828 | $1,657 | $828 |
| Replace with Aqueous Cleaning | $828 | $19,331 | $18,503 |
| Hybrid system (e.g., Inventec, HEMO) | $828 | $6,490 | $5,661 |
| Small/High Precision Cleaning | Replace with Airless Degreaser with PCE | $21 | $33 | $13 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $21 | $41 | $21 |
| Replace with Aqueous Cleaning | $21 | $483 | $463 |
| Hybrid system (e.g., Inventec, HEMO) | $21 | $162 | $142 |
| Medium/High Precision Cleaning | Replace with Airless Degreaser with PCE | $259 | $419 | $160 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $259 | $518 | $259 |
| Co-Solvent, Bi-Solvent | $259 | $144 | ($115) |
| Semi-Aqueous | $259 | $1,723 | $1,464 |
| Replace with Aqueous Cleaning | $259 | $6,041 | $5,782 |
| Hybrid system (e.g., Inventec, HEMO) | $259 | $2,028 | $1,769 |
| Large/High Precision Cleaning | Replace with Airless Degreaser with PCE | $828 | $1,339 | $511 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $828 | $1,657 | $828 |
| Replace with Aqueous Cleaning | $828 | $19,331 | $18,503 |
| Hybrid system (e.g., Inventec, HEMO) | $828 | $6,490 | $5,661 |
| Small/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $21 | $33 | $13 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $21 | $41 | $21 |
| Replace with Aqueous Cleaning | $21 | $483 | $463 |
| Hybrid system (e.g., Inventec, HEMO) | $21 | $162 | $142 |
| Medium/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $259 | $419 | $160 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $259 | $518 | $259 |
| Co-Solvent, Bi-Solvent | $259 | $144 | ($115) |
| Semi-Aqueous | $259 | $1,723 | $1,464 |
| Replace with Aqueous Cleaning | $259 | $6,041 | $5,782 |
| Hybrid system (e.g., Inventec, HEMO) | $259 | $2,028 | $1,769 |
| Large/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | $828 | $1,339 | $511 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $828 | $1,657 | $828 |
| Replace with Aqueous Cleaning | $828 | $19,331 | $18,503 |
| Hybrid system (e.g., Inventec, HEMO) | $828 | $6,490 | $5,661 |
| Small/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | $21 | $33 | $13 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $21 | $41 | $21 |
| Replace with Aqueous Cleaning | $21 | $483 | $463 |
| Medium/Start-Up/R&D Critical Cleaning | Replace with Airless Degreaser with PCE | $259 | $419 | $160 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | $259 | $518 | $259 |
| Co-Solvent, Bi-Solvent | $259 | $144 | ($115) |
| Semi-Aqueous | $259 | $1,723 | $1,464 |
| Replace with Aqueous Cleaning | $259 | $6,041 | $5,782 |

### Additional Floorspace Costs

Floorspace costs are based on a study done in 1999 with BFK Solutions and the Toxics Use Reduction Institute ([Kanegsburg and LeBlanc 1999](#_ENREF_35)). Estimated costs are added if multiple pieces of the cleaning systems are needed (examples include the cleaning system, rinsing tank and dryer)

For the cleaning types and methods estimated to require additional floorspace, Table 7‑27 presents the estimated annual incremental costs. Among those facilities with incremental costs, the costs range from about $100 to $9,000 in additional floorspace.

| Table 7‑27: Annual Additional Floorspace Costs, by Size, Cleaning Category, and Alternative Cleaning Method (2022$) | | | |
| --- | --- | --- | --- |
| Size/Cleaning Category | Alternative Cleaning Method | Additional Floorspace Required (square feet) | Incremental Cost  ($7.03/sqft) |
| Small/General Cleaning | Replace with Airless Degreaser with PCE | 20 | $141 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 20 | $141 |
| OTVD for Very low flashpoint (<0C) solvent | 20 | $141 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 20 | $141 |
| Co-Solvent, Bi-Solvent | 40 | $281 |
| Replace with Aqueous Cleaning | 65 | $457 |
| Hybrid system (e.g., Inventec, HEMO) | 30 | $211 |
| Medium/General Cleaning | Replace with Airless Degreaser with PCE | 200 | $1,406 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 200 | $1,406 |
| OTVD for Very low flashpoint (<0C) solvent | 200 | $1,406 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 200 | $1,406 |
| Co-Solvent, Bi-Solvent | 400 | $2,812 |
| Replace with Aqueous Cleaning | 650 | $4,570 |
| Hybrid system (e.g., Inventec, HEMO) | 280 | $1,968 |
| Large/General Cleaning | Replace with Airless Degreaser with PCE | 400 | $2,812 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 400 | $2,812 |
| OTVD for Very low flashpoint (<0C) solvent | 400 | $2,812 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 400 | $2,812 |
| Co-Solvent, Bi-Solvent | 800 | $5,624 |
| Replace with Aqueous Cleaning | 1,300 | $9,139 |
| Small/High Precision Cleaning | Replace with Airless Degreaser with PCE | 20 | $141 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 20 | $141 |
| OTVD for Very low flashpoint (<0C) solvent | 20 | $141 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 20 | $141 |
| Co-Solvent, Bi-Solvent | 40 | $281 |
| Replace with Aqueous Cleaning | 65 | $457 |
| Hybrid system (e.g., Inventec, HEMO) | 30 | $211 |
| Medium/High Precision Cleaning | Replace with Airless Degreaser with PCE | 200 | $1,406 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 200 | $1,406 |
| OTVD for Very low flashpoint (<0C) solvent | 200 | $1,406 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 200 | $1,406 |
| Co-Solvent, Bi-Solvent | 400 | $2,812 |
| Replace with Aqueous Cleaning | 650 | $4,570 |
| Hybrid system (e.g., Inventec, HEMO) | 280 | $1,968 |
| Large/High Precision Cleaning | Replace with Airless Degreaser with PCE | 400 | $2,812 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 400 | $2,812 |
| OTVD for Very low flashpoint (<0C) solvent | 400 | $2,812 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 400 | $2,812 |
| Co-Solvent, Bi-Solvent | 800 | $5,624 |
| Replace with Aqueous Cleaning | 1,300 | $9,139 |
| Small/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | 20 | $141 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 20 | $141 |
| OTVD for Very low flashpoint (<0C) solvent | 20 | $141 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 20 | $141 |
| Co-Solvent, Bi-Solvent | 40 | $281 |
| Replace with Aqueous Cleaning | 65 | $457 |
| Hybrid system (e.g., Inventec, HEMO) | 30 | $211 |
| Medium/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | 200 | $1,406 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 200 | $1,406 |
| OTVD for Very low flashpoint (<0C) solvent | 200 | $1,406 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 200 | $1,406 |
| Co-Solvent, Bi-Solvent | 400 | $2,812 |
| Replace with Aqueous Cleaning | 650 | $4,570 |
| Hybrid system (e.g., Inventec, HEMO) | 280 | $1,968 |
| Large/Safety Critical Cleaning | Replace with Airless Degreaser with PCE | 400 | $2,812 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 400 | $2,812 |
| OTVD for Very low flashpoint (<0C) solvent | 400 | $2,812 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 400 | $2,812 |
| Co-Solvent, Bi-Solvent | 800 | $5,624 |
| Replace with Aqueous Cleaning | 1,300 | $9,139 |

### Incremental Costs for Vapor Degreasing Facilities Switching to Methylene Chloride Alternatives

Table 7‑28 through Table 7‑38 present the initial and recurring costs for each size, cleaning category, and alternative cleaning method combination considered. EPA asked BFK Solutions to estimate a percentage weight for each alternative cleaning method that indicates how likely affected vapor degreasers would be to adopt each method. They provided two sets of percentages, one under a scenario where trans-DCE was considered a viable alternative cleaning method and a second scenario where it was not. Note that the estimated percentage weights intentionally sum to more than 100 percent to account for instances where a facility switches from using methylene chloride vapor degreasing to multiple cleaning methods.

| Table 7‑28: Initial and Recurring Costs by Alternative Cleaning Method: Small/General Cleaning (2022$) | | | | |
| --- | --- | --- | --- | --- |
| Alternative Cleaning Method | Weight1 | | Initial Costs | Annual Recurring Costs |
| with trans-DCE | without trans-DCE |
| Replace with Airless Degreaser with PCE | 10% | 15% | $480,900 | ($15,224) |
| Convert OTVD to use Flashpoint inerted t-DCE | 10% | 0% | $191,800 | $8,724 |
| Replace with OTVD using Flashpoint inerted t-DCE | 9% | 0% | $242,800 | $8,724 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 8% | 10% | $281,800 | $8,461 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 1% | 1% | $348,240 | $3,728 |
| OTVD for Very low flashpoint (<0C) solvent | 0% | 0% | $364,300 | $5,178 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 20% | 30% | $522,180 | ($14,094) |
| Co-Solvent, Bi-Solvent | 5% | 8% | $635,911 | $27,587 |
| High boiling, non-vacuum, non-rinse | 15% | 20% | $177,160 | ($6,192) |
| Semi-Aqueous | 15% | 20% | $282,348 | ($1,642) |
| Replace with Aqueous Cleaning | 20% | 25% | $340,597 | $12,956 |
| Hybrid system (e.g., Inventec, HEMO) | 7% | 10% | $606,800 | $21,690 |
| **Weighted Average Across Methods (Including trans-DCE)** |  |  | **$430,902** | **$2,344** |
| **Weighted Average Across Methods (Excluding trans-DCE)** |  |  | **$549,055** | **$420** |
| 1Weights sum to more than 100 percent in order to account for switching to multiple cleaning methods | | | | |

| Table 7‑29: Initial and Recurring Costs by Alternative Cleaning Method: Medium/General Cleaning (2022$) | | | | |
| --- | --- | --- | --- | --- |
| Cleaning method | Weight1 | | Initial Costs | Annual Recurring Costs |
| with trans-DCE | without trans-DCE |
| Replace with Airless Degreaser with PCE | 12% | 15% | $698,750 | ($109,222) |
| Convert OTVD to use Flashpoint inerted t-DCE | 10% | 0% | $263,500 | $153,438 |
| Replace with OTVD using Flashpoint inerted t-DCE | 9% | 0% | $589,500 | $165,788 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 8% | 10% | $749,500 | $121,338 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 1% | 1% | $677,000 | ($63,645) |
| OTVD for Very low flashpoint (<0C) solvent | 0% | 0% | $678,250 | ($54,565) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 25% | 35% | $775,750 | ($102,944) |
| Co-Solvent, Bi-Solvent | 5% | 8% | $711,813 | $20,763 |
| High boiling, non-vacuum, non-rinse | 15% | 20% | $195,500 | ($77,141) |
| Semi-Aqueous | 15% | 20% | $589,250 | ($52,868) |
| Replace with Aqueous Cleaning | 20% | 25% | $609,644 | ($52,146) |
| Hybrid system (e.g., Inventec, HEMO) | 7% | 10% | $958,200 | $113,567 |
| **Weighted Average Across Methods (Including trans-DCE)** |  |  | **$766,228** | **($20,450)** |
| **Weighted Average Across Methods (Excluding trans-DCE)** |  |  | **$920,171** | **($66,937)** |
| 1Weights sum to more than 100 percent in order to account for switching to multiple cleaning methods | | | | |

| Table 7‑30: Initial and Recurring Costs by Alternative Cleaning Method: Large/General Cleaning (2022$) | | | | |
| --- | --- | --- | --- | --- |
| Cleaning method | Weight1 | | Initial Costs | Annual Recurring Costs |
| with trans-DCE | without trans-DCE |
| Replace with Airless Degreaser with PCE | 12% | 15% | $5,060,000 | ($239,095) |
| Convert OTVD to use Flashpoint inerted t-DCE | 10% | 0% | $298,000 | $352,814 |
| Replace with OTVD using Flashpoint inerted t-DCE | 9% | 0% | $3,901,000 | $527,039 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 8% | 10% | $5,692,000 | $464,752 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 1% | 1% | $5,004,000 | ($180,625) |
| OTVD for Very low flashpoint (<0C) solvent | 0% | 0% | $5,008,000 | ($157,395) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 30% | 40% | $6,184,000 | ($211,435) |
| Co-Solvent, Bi-Solvent | 5% | 8% | $609,400 | ($170,158) |
| High boiling, non-vacuum, non-rinse | 15% | 20% | $228,400 | ($435,952) |
| Semi-Aqueous | 18% | 22% | $365,200 | ($431,998) |
| Replace with Aqueous Cleaning | 20% | 25% | $5,085,144 | ($127,874) |
| Hybrid system (e.g., Inventec, HEMO) | 7% | 10% | $7,171,200 | ($73,934) |
| **Weighted Average Across Methods (Including trans-DCE)** |  |  | **$4,998,169** | **($156,444)** |
| **Weighted Average Across Methods (Excluding trans-DCE)** |  |  | **$6,015,022** | **($310,974)** |
| 1Weights sum to more than 100 percent in order to account for switching to multiple cleaning methods | | | | |

| Table 7‑31: Initial and Recurring Costs by Alternative Cleaning Method: Small/High Precision (2022$) | | | | |
| --- | --- | --- | --- | --- |
| Cleaning method | Weight1 | | Initial Costs | Annual Recurring Costs |
| with trans-DCE | Without trans-DCE |
| Replace with Airless Degreaser with PCE | 15% | 25% | $644,681 | ($8,855) |
| Convert OTVD to use Flashpoint inerted t-DCE | 20% | 0% | $355,581 | $7,364 |
| Replace with OTVD using Flashpoint inerted t-DCE | 20% | 0% | $397,581 | $7,364 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 12% | 15% | $427,581 | $6,755 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 5% | 8% | $512,021 | $4,167 |
| OTVD for Very low flashpoint (<0C) solvent | 1% | 2% | $512,081 | $4,572 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 20% | 33% | $685,961 | ($7,529) |
| Co-Solvent, Bi-Solvent | 5% | 15% | $579,692 | $13,692 |
| Semi-Aqueous | 2% | 5% | $446,129 | ($1,093) |
| Replace with Aqueous Cleaning | 15% | 20% | $551,453 | $11,332 |
| Hybrid system (e.g., Inventec, HEMO) | 10% | 18% | $670,581 | $15,722 |
| **Weighted Average Across Methods (Including trans-DCE)** |  |  | **$654,242** | **$5,111** |
| **Weighted Average Across Methods (Excluding trans-DCE)** |  |  | **$843,133** | **$3,835** |
| 1Weights sum to more than 100 percent in order to account for switching to multiple cleaning methods | | | | |

| Table 7‑32: Initial and Recurring Costs by Alternative Cleaning Method: Medium/High Precision (2022$) | | | | |
| --- | --- | --- | --- | --- |
| Cleaning method | Weight1 | | Initial Costs | Annual Recurring Costs |
| With trans-DCE | Without trans-DCE |
| Replace with Airless Degreaser with PCE | 15% | 25% | $862,531 | ($93,206) |
| Convert OTVD to use Flashpoint inerted t-DCE | 20% | 0% | $391,281 | $149,459 |
| Replace with OTVD using Flashpoint inerted t-DCE | 20% | 0% | $742,281 | $149,459 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 12% | 15% | $913,281 | $110,646 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 5% | 8% | $856,781 | ($55,251) |
| OTVD for Very low flashpoint (<0C) solvent | 1% | 2% | $428,031 | ($73,876) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 20% | 33% | $854,531 | ($99,676) |
| Co-Solvent, Bi-Solvent | 5% | 15% | $877,594 | $43,546 |
| Semi-Aqueous | 2% | 5% | $753,031 | ($46,968) |
| Replace with Aqueous Cleaning | 15% | 20% | $793,833 | ($66,457) |
| Hybrid system (e.g., Inventec, HEMO) | 10% | 18% | $1,121,981 | $127,471 |
| **Weighted Average Across Methods (Including trans-DCE)** |  |  | **$973,925** | **$39,660** |
| **Weighted Average Across Methods (Excluding trans-DCE)** |  |  | **$1,241,737** | **($31,659)** |
| 1Weights sum to more than 100 percent in order to account for switching to multiple cleaning methods | | | | |

| Table 7‑33: Initial and Recurring Costs by Alternative Cleaning Method: Large/High Precision (2022$) | | | | |
| --- | --- | --- | --- | --- |
| Cleaning method | Weight1 | | Initial Costs | Annual Recurring Costs |
| with trans-DCE | without trans-DCE |
| Replace with Airless Degreaser with PCE | 15% | 25% | $5,223,781 | ($229,048) |
| Convert OTVD to use Flashpoint inerted t-DCE | 20% | 0% | $464,781 | $350,280 |
| Replace with OTVD using Flashpoint inerted t-DCE | 20% | 0% | $4,064,781 | $350,280 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 12% | 15% | $5,855,781 | $462,217 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 5% | 8% | $5,167,781 | ($178,020) |
| OTVD for Very low flashpoint (<0C) solvent | 1% | 2% | $5,171,781 | ($154,790) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 20% | 33% | $5,182,781 | ($205,083) |
| Co-Solvent, Bi-Solvent | 5% | 15% | $3,685,181 | ($551,328) |
| Semi-Aqueous | 2% | 5% | $528,981 | ($429,393) |
| Replace with Aqueous Cleaning | 15% | 20% | $5,099,333 | ($175,596) |
| Hybrid system (e.g., Inventec, HEMO) | 10% | 18% | $7,334,981 | $1,305,573 |
| **Weighted Average Across Methods (Including trans-DCE)** |  |  | **$5,432,073** | **$177,819** |
| **Weighted Average Across Methods (Excluding trans-DCE)** |  |  | **$7,330,878** | **$22,771** |
| 1Weights sum to more than 100 percent in order to account for switching to multiple cleaning methods | | | | |

| Table 7‑34: : Initial and Recurring Costs by Alternative Cleaning Method: Small/Safety Critical (2022$) | | | | |
| --- | --- | --- | --- | --- |
| Cleaning method | Weight1 | | Initial Costs | Annual Recurring Costs |
| With trans-DCE | Without trans-DCE |
| Replace with Airless Degreaser with PCE | 20% | 30% | $1,845,888 | ($8,793) |
| Convert OTVD to use Flashpoint inerted t-DCE | 20% | 0% | $1,559,788 | $7,872 |
| Replace with OTVD using Flashpoint inerted t-DCE | 20% | 0% | $1,607,788 | $7,927 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 15% | 18% | $1,628,788 | $6,755 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 12% | 15% | $1,713,228 | $4,130 |
| OTVD for Very low flashpoint (<0C) solvent | 2% | 2% | $1,713,288 | $4,535 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 25% | 33% | $1,852,168 | ($9,655) |
| Co-Solvent, Bi-Solvent | 8% | 15% | $1,780,899 | $13,655 |
| Semi-Aqueous | 2% | 5% | $1,647,336 | ($1,129) |
| Replace with Aqueous Cleaning | 15% | 20% | $1,163,453 | $4,092 |
| Hybrid system (e.g., Inventec, HEMO) | 10% | 18% | $1,971,788 | $21,972 |
| **Weighted Average Across Methods (Including trans-DCE)** |  |  | **$2,497,022** | **$4,468** |
| **Weighted Average Across Methods (Excluding trans-DCE)** |  |  | **$2,686,528** | **$2,867** |
| 1Weights sum to more than 100 percent in order to account for switching to multiple cleaning methods | | | | |

| Table 7‑35: : Initial and Recurring Costs by Alternative Cleaning Method: Medium/Safety Critical (2022$) | | | | |
| --- | --- | --- | --- | --- |
| Cleaning method | Weight1 | | Initial Costs | Annual Recurring Costs |
| with trans-DCE | without trans-DCE |
| Replace with Airless Degreaser with PCE | 20% | 30% | $2,063,738 | ($93,206) |
| Convert OTVD to use Flashpoint inerted t-DCE | 20% | 0% | $1,727,488 | ($95,042) |
| Replace with OTVD using Flashpoint inerted t-DCE | 20% | 0% | $1,943,488 | $149,459 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 15% | 18% | $2,114,488 | $110,646 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 12% | 15% | $2,057,988 | ($55,251) |
| OTVD for Very low flashpoint (<0C) solvent | 2% | 2% | $2,059,238 | ($47,001) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 25% | 33% | $2,055,738 | ($76,576) |
| Co-Solvent, Bi-Solvent | 8% | 15% | $2,078,801 | ($79,077) |
| Semi-Aqueous | 2% | 5% | $1,954,238 | ($46,968) |
| Replace with Aqueous Cleaning | 15% | 20% | $1,605,833 | ($57,457) |
| Hybrid system (e.g., Inventec, HEMO) | 10% | 18% | $2,323,188 | $39,892 |
| **Weighted Average Across Methods (Including trans-DCE)** |  |  | **$2,944,776** | **($29,770)** |
| **Weighted Average Across Methods (Excluding trans-DCE)** |  |  | **$3,176,878** | **($61,064)** |
| 1Weights sum to more than 100 percent in order to account for switching to multiple cleaning methods | | | | |

| Table 7‑36: : Initial and Recurring Costs by Alternative Cleaning Method: Large/Safety Critical (2022$) | | | | |
| --- | --- | --- | --- | --- |
| Cleaning method | Weight1 | | Initial Costs | Annual Recurring Costs |
| with trans-DCE | without trans-DCE |
| Replace with Airless Degreaser with PCE | 20% | 30% | $6,424,988 | ($222,504) |
| Convert OTVD to use Flashpoint inerted t-DCE | 20% | 0% | $2,385,988 | $170,280 |
| Replace with OTVD using Flashpoint inerted t-DCE | 20% | 0% | $5,265,988 | $350,280 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 15% | 18% | $7,056,988 | $462,217 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 12% | 15% | $6,368,988 | ($178,020) |
| OTVD for Very low flashpoint (<0C) solvent | 2% | 2% | $6,372,988 | ($154,790) |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 25% | 33% | $6,383,988 | ($205,083) |
| Co-Solvent, Bi-Solvent | 8% | 15% | $6,486,388 | ($251,828) |
| Semi-Aqueous | 2% | 5% | $3,170,188 | ($339,393) |
| Replace with Aqueous Cleaning | 15% | 20% | $5,911,333 | ($175,596) |
| Hybrid system (e.g., Inventec, HEMO) | 10% | 18% | $8,516,188 | $1,304,323 |
| **Weighted Average Across Methods (Including trans-DCE)** |  |  | **$8,682,310** | **$130,374** |
| **Weighted Average Across Methods (Excluding trans-DCE)** |  |  | **$10,233,926** | **$63,887** |
| 1Weights sum to more than 100 percent in order to account for switching to multiple cleaning methods | | | | |

| Table 7‑37: Initial and Recurring Costs by Alternative Cleaning Method: Small/R&D Safety Critical (2022$) | | | | |
| --- | --- | --- | --- | --- |
| Cleaning method | Weight1 | | Initial Costs | Annual Recurring Costs |
| with trans-DCE | without trans-DCE |
| Replace with Airless Degreaser with PCE | 15% | 35% | $723,875 | $12,227 |
| Convert OTVD to use Flashpoint inerted t-DCE | 17% | 0% | $434,775 | $7,872 |
| Replace with OTVD using Flashpoint inerted t-DCE | 17% | 0% | $485,775 | $7,927 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 25% | 32% | $506,775 | $6,755 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 12% | 18% | $591,215 | $3,990 |
| OTVD for Very low flashpoint (<0C) solvent | 1% | 1% | $591,275 | $4,395 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 17% | 30% | $730,155 | ($71) |
| Co-Solvent, Bi-Solvent | 10% | 16% | $658,886 | $13,374 |
| Semi-Aqueous | 7% | 10% | $525,323 | ($1,129) |
| Replace with Aqueous Cleaning | 15% | 20% | $478,428 | $13,359 |
| **Weighted Average Across Methods (Including trans-DCE)** |  |  | **$767,179** | **$9,981** |
| **Weighted Average Across Methods (Excluding trans-DCE)** |  |  | **$1,000,542** | **$11,881** |
| 1Weights sum to more than 100 percent in order to account for switching to multiple cleaning methods | | | | |

| Table 7‑38: Initial and Recurring Costs by Alternative Cleaning Method: Medium/R&D Safety Critical (2022$) | | | | |
| --- | --- | --- | --- | --- |
| Cleaning method | Weight1 | | Initial Costs | Annual Recurring Costs |
| with trans-DCE | without trans-DCE |
| Replace with Airless Degreaser with PCE | 15% | 35% | $941,725 | $4,603 |
| Convert OTVD to use Flashpoint inerted t-DCE | 17% | 0% | $470,475 | $38,339 |
| Replace with OTVD using Flashpoint inerted t-DCE | 17% | 0% | $1,181,475 | $269,339 |
| Replace with Solstice system (trans-1-chloro-3,3,3,trifluoropropene) | 25% | 32% | $992,475 | $13,266 |
| OTVD for Low boiling point (<100C) Alcohol or other flammable | 12% | 18% | $935,975 | $40,723 |
| OTVD for Very low flashpoint (<0C) solvent | 1% | 1% | $937,225 | $48,973 |
| EVD for High Boiling Point Combustibles (>100C) Hydrocarbons and Alcohols | 17% | 30% | $933,725 | $21,232 |
| Co-Solvent, Bi-Solvent | 10% | 16% | $956,788 | $15,491 |
| Semi-Aqueous | 7% | 10% | $832,225 | $50,412 |
| Replace with Aqueous Cleaning | 15% | 20% | $920,808 | $37,189 |
| **Weighted Average Across Methods (Including trans-DCE)** |  |  | **$1,242,687** | **$75,954** |
| **Weighted Average Across Methods (Excluding trans-DCE)** |  |  | **$1,525,631** | **$35,003** |
| 1Weights sum to more than 100 percent in order to account for switching to multiple cleaning methods | | | | |

Table 7‑39 and Table 7‑40 present a summary of the incremental costs for facilities using methylene chloride for vapor degreasing that switch to an alternative cleaning method. The primary estimates used in the analysis are presented in Table 7‑40 (assuming trans-DCE cleaning methods are not a viable option).

| Table 7‑39: Summary of Incremental Costs for Vapor Degreasing: Including Trans-DCE (2022$) | | | |
| --- | --- | --- | --- |
| Size/Type | Size/Type Percentage Weight | Initial Costs | Recurring Annual Costs |
| Small/General Cleaning | 1.70% | $430,902 | $2,344 |
| Medium/General Cleaning | 6.80% | $766,228 | ($20,450) |
| Large/General Cleaning | 8.50% | $4,998,169 | ($156,444) |
| Small/High Precision Cleaning | 6.10% | $654,242 | $5,111 |
| Medium/High Precision Cleaning | 24.40% | $973,925 | $39,660 |
| Large/High Precision Cleaning | 30.50% | $5,432,073 | $177,819 |
| Small/Safety Critical Cleaning | 1.70% | $2,497,022 | $4,468 |
| Medium/Safety Critical Cleaning | 6.80% | $2,944,776 | ($29,770) |
| Large/Safety Critical Cleaning | 8.50% | $8,682,310 | $130,374 |
| Small/Start-Up/R&D Critical Cleaning | 1.00% | $767,179 | $9,981 |
| Medium/Start-Up/R&D Critical Cleaning | 4.00% | $1,242,687 | $75,954 |
| **All Types Combined** | **-** | **$3,457,000** | **$62,000** |

| Table 7‑40: Summary of Incremental Costs for Vapor Degreasing: Excluding Trans-DCE (2022$) | | | |
| --- | --- | --- | --- |
| Size/Type | Size/Type Percentage Weight | Initial Costs | Recurring Annual Costs |
| Small/General Cleaning | 1.70% | $549,055 | $420 |
| Medium/General Cleaning | 6.80% | $920,171 | ($66,937) |
| Large/General Cleaning | 8.50% | $6,015,022 | ($310,974) |
| Small/High Precision Cleaning | 6.10% | $843,133 | $3,835 |
| Medium/High Precision Cleaning | 24.40% | $1,241,737 | ($31,659) |
| Large/High Precision Cleaning | 30.50% | $7,330,878 | $22,771 |
| Small/Safety Critical Cleaning | 1.70% | $2,686,528 | $2,867 |
| Medium/Safety Critical Cleaning | 6.80% | $3,176,878 | ($61,064) |
| Large/Safety Critical Cleaning | 8.50% | $10,233,926 | $63,887 |
| Small/Start-Up/R&D Critical Cleaning | 1.00% | $1,000,542 | $11,881 |
| Medium/Start-Up/R&D Critical Cleaning | 4.00% | $1,525,631 | $35,003 |
| **All Types Combined** | **-** | **$4,376,000** | **($29,000)** |

## Dermal Protection Costs

The estimated costs associated with developing and implementing a dermal protection program are presented in section 7.9.1 and the estimated costs for dermal PPE (gloves) are presented in section 7.9.2. The total dermal protection control costs are summarized in section 7.9.3.

### Dermal Exposure Control Program Costs

Dermal exposure control program costs include planning how to implement dermal exposure controls and training employees on dermal exposure control:

* **Developing a dermal exposure control program –** Identifyeach person reasonably likely to be exposed, identify appropriate gloves to use for dermal protection, and set up training program. EPA assumes an average of 5 hours per facility by an industrial hygienist to develop a dermal exposure control program.
* **Training** – EPA assumes potentially exposed workers will have an hour of training on dermal protection annually. The training is assumed to be performed by an industrial hygienist, who is assumed to perform the training for four workers at a time.

Table 7‑41 and Table 7‑42 present unit costs for developing a dermal exposure control program and dermal protection training.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 7‑41: Develop Dermal Exposure Control Program (per facility) | | | |
| Labor Burden | Units | Labor Rate | Initial Costs |
| 5 | hours | $71.32 | $356.60 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 7‑42: Conduct Dermal Protection Training (per worker) | | | | |
| Sector | Annual Labor Burden1 | Units | Labor Rate1 | Annual Costs |
| Manufacturing | 1.25 | hours | $46.35 | $57.93 |
| Transportation and Public Utilities | $58.78 | $73.47 |
| Services | $54.14 | $67.68 |
| 1Each worker is assumed to require an hour of training annually and an industrial hygienist is assumed to deliver the training to four workers at a time, so the total labor burden is 1.25 hours per worker (1 hour of the worker’s time and 0.25 hours of the industrial hygienist’s time). Thus, the labor rate is a blended rate of the worker and industrial hygienist’s wage. | | | | |

### Estimated Costs for Dermal PPE

Estimating the costs for dermal PPE involves identifying the types of gloves expected to be used in order to achieve compliance, obtaining the glove unit costs, estimating annual per-employee glove costs, accounting for the gloves’ useful life, and applying the annual per-employee glove costs to the estimated number of employees required to have dermal protection.

#### Gloves Selected for Cost Analysis

Gloves are manufactured to meet the needs of a range of industries and hazards, and thus vary in properties such as material and thickness. For protection against hazardous chemicals, the appropriateness of any given glove will depend on the type of chemical, the type of exposure (*e.g.*, splash protection, immersion), the length of exposure, dexterity requirements, thermal protection, and comfort. There are several commonly used materials to protect against chemical hazards ([OSHA 2004](#_ENREF_45); [Grainger 2019](#_ENREF_21)):

1. **Butyl** – a synthetic rubber that protects against a wide variety of chemicals and are resistant to oxidation and abrasion. Does not perform well with aliphatic and aromatic hydrocarbons and halogenated solvents.
2. **Natural rubber (latex)** – often used as a general-purpose glove that is resistant to temperature and abrasion, with good elasticity and comfort. Protects against most water solutions of acids, alkalis, salts, and ketones.
3. **Neoprene** – a synthetic rubber that protects against petroleum products, alcohols, organic acids, and alkalis. Provides good dexterity and wear resistance.
4. **Nitrile** – often used as a general-purpose glove that provides protection against chlorinated solvents, as well as oils, greases, petroleum products, acids, caustics, and alcohols. Does not perform well with strong oxidizing agents, aromatic solvents, ketones, and acetates.
5. **Viton® -** provides protection against chlorinated and aromatic solvents. Has low resistance to abrasion.
6. **Polyvinyl chloride (PVC)** – provides protection against most acids, fats, and petroleum hydrocarbons. Resistant to abrasion.
7. **Polyvinyl alcohol (PVA) –** a water-soluble material that provides protection against aromatic and chlorinated solvents. Cannot be used in water or water-based solutions.

PVA gloves provide the best protection against chlorinated solvents like methylene chloride, so EPA assumes PVA gloves will be the most common choice for compliance with dermal protection requirements. Table 7‑43 presents the unit cost per pair for the gloves used in the cost analysis.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 7‑43: Unit Cost per Pair of Gloves | | | | |
| Brand | Model | Material | Price | Price per Pair |
| Ansell | PVA 15-554 | cotton lined PVA | $44.93/dozen pairs | $3.74 |
| Source: [Autumn Supply (2022)](#_ENREF_6) | | | | |

#### Dermal PPE Unit Cost Per-Employee

To cost this option, the assumption is that firms adopt appropriate procedures for glove changing. EPA assumes a useful life of 1 week for the supported PVA gloves. Table 7‑44 presents the cost per-worker for gloves.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 7‑44: Annual Per-Worker Cost for Dermal PPE | | | | |
| Glove Type | Unit Cost | Useful Life (yrs)\* | Pairs per Year per Worker | Annual Costs |
| Supported/Lined PVA | $4.04 | 0.02 | 50 | $202 |
| \*1 pair per week/50 work weeks per year  Source: [Autumn Supply (2022)](#_ENREF_6) | | | | |

### Summary of Dermal Protection Costs

Table 7‑45 summarizes the total initial and annual dermal protection control costs.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Table 7‑45: Total Dermal Protection Control Plan Costs, by Use Category (2022$) | | | | | | |
| Use Category | Number of Affected Facilities | Per Facility Costs (Initial) | Number of Affected Workers | Per  Worker Costs (annual) | Total Costs | |
| Initial | Annual |
| Manufacturing | 6 | $356.60 | 533 | $260.14 | $2,140 | $138,656 |
| Import/Repackage | 26 | $356.60 | 587 | $260.14 | $9,272 | $152,703 |
| Processing as a reactant | 35 | $356.60 | 703 | $260.14 | $12,481 | $182,880 |
| Incorporation Into Formulation, Mixture, or Reaction Product | 54 | $356.60 | 310 | $260.14 | $19,256 | $80,644 |
| Waste Handling, Disposal, Treatment, and Recycling | 1,091 | $356.60 | 7,493 | $275.68 | $389,051 | $2,065,685 |
| Laboratory Use | 56 | $356.60 | 183 | $260.14 | $19,970 | $47,606 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | 44 | $356.60 | 352 | $260.14 | $15,690 | $91,570 |
| Aerospace Paint and Coating Removers | 272 | $356.60 | 762 | $260.14 | $96,995 | $198,228 |
| Cellulose Triacetate Film Production | 1 | $356.60 | 5 | $260.14 | $357 | $1,301 |
| Furniture Refinishing | 4,899 | $356.60 | 11,625 | $260.14 | $1,746,983 | $3,024,151 |
| Glues, Sealants, Adhesives, and Caulks | 3,986 | $356.60 | 40,862 | $260.14 | $1,421,408 | $10,629,924 |

## Exposure Monitoring and Respiratory Protection Costs

This section presents preliminary cost estimates for the exposure monitoring and respiratory protection requirements associated with an Existing Chemical Exposure Limit (ECEL) of 2 ppm as an 8 hour time-weighted average for methylene chloride and an action level (AL) of 1 ppm as an 8 hour time-weighted average (TWA). EPA has also developed a short-term ECEL of 16 ppm (57 mg/m3) as a 15-mintue TWA ([EPA 2020c](#_ENREF_98)). The requirements under the WCPP requirements vary according to how far above the action level or limit the exposure levels found during monitoring are. The different requirements for monitoring results are presented in Table 7‑46.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 7‑46: Monitoring Threshold Requirements | | | |
| Exposure Threshold | Monitoring Requirements | Personal Protective Equipment (PPE) Requirements | Notification and Recordkeeping Requirements |
| ≤1 ppm (8 hour TWA)  <=8 ppm (15 min TWA) | Initial exposure monitoring | No respiratory protection | Notify employee of exposure monitoring results within 15 days of receipt of results  Retain compliance records for 5 years |
| 1-2 ppm (8 hour TWA)  8-16 ppm (15 min TWA) | Initial exposure monitoring  Periodic exposure monitoring every six months | No respiratory protection | Notify employee of exposure monitoring results within 15 days of receipt of results  Retain compliance records for 5 years |
| 2-20 ppm (8 hour TWA)  16-160 ppm (15 min TWA) | Initial exposure monitoring  Periodic exposure monitoring every three months | APF 10 supplied air respirators | Notify employee of exposure monitoring results within 15 days of receipt of results  Retain compliance records for 5 years |
| 20-50 ppm (8 hour TWA)  160-400 ppm (15 min TWA) | Initial exposure monitoring  Periodic exposure monitoring every three months | APF 25 supplied air respirators | Notify employee of exposure monitoring results within 15 days of receipt of results  Retain compliance records for 5 years |
| 50-100 ppm (8 hour TWA)  400-800 ppm (15 min TWA) | Initial exposure monitoring  Periodic exposure monitoring every three months | APF 50 supplied air respirator | Notify employee of exposure monitoring results within 15 days of receipt of results  Retain compliance records for 5 years |
| 100-2,000 ppm (8 hour TWA)  800-16,000 ppm (15 min TWA) | Initial exposure monitoring  Periodic exposure monitoring every three months | APF 1,000 supplied air respirator | Notify employee of exposure monitoring results within 15 days of receipt of results  Retain compliance records for 5 years |
| 2,000-20,000 ppm (8 hour TWA)  16,000-160,000 ppm (15 min TWA) | Initial exposure monitoring  Periodic exposure monitoring every three months | APF 10,000 supplied air respirator | Notify employee of exposure monitoring results within 15 days of receipt of results  Retain compliance records for 5 years |

Note that before resorting to compliance through using PPE, engineering or administrative controls should be used to lower exposure to below the action level. The costs of engineering and administrative controls are site-specific and depend on the extent to which controls are already in place, which is unknown. Thus, for the purpose of estimating costs (and benefits), EPA assumes that PPE is used. Note that is an assumption made for the purpose of estimating costs only, not an assumption about how facilities will actually comply with WCPP requirements. As noted in section 7.13.5, the WCPP requires the implementation of engineering and administrative controls where feasible, before resorting to PPE use. These controls would need to be implemented even if they are more expensive than achieving compliance through a PPE program. However, since PPE programs are costly, achieving compliance through engineering and/or administrative controls may be less expensive than the estimated PPE costs.

The costs for compliance with the monitoring and respiratory protection requirements under the WCPP include initial exposure monitoring, required PPE for the different thresholds outlined above in Table 7‑46, periodic exposure monitoring, and notifications and recordkeeping.

To determine the number of entities with exposure monitoring results at the different thresholds, EPA used the median and 95th percentile exposure levels presented in the final risk evaluation ([EPA 2020i](#_ENREF_104)) and estimated the distribution assuming the exposures were distributed across facilities according to a log normal distribution. EPA estimated the 8 hour TWA and 15 minute TWA exposure distributions and used the higher threshold category for estimating which threshold monitoring category an entity fell under. Most conditions of use in the risk evaluation only have the 8 hour TWA data available, so the 8 hour TWA data was used alone to determine the exposure monitoring threshold categories in these instances.

In order to estimate costs (and benefits), EPA assumed that the variation in exposure is reflected across the entities rather than the workers. Table 7‑47 and Table 7‑48 present the respective estimated numbers of entities and workers in each ECEL threshold category.

| Table 7‑47. Count of Entities, by Use Category and Exposure Threshold | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Use Category | <Action Level | Between Action Level and Limit | < 10 times the ECEL | < 25 times the ECEL | < 50 times the ECEL | < 1,000 times the ECEL | < 10,000 times the ECEL | Total |
| Manufacturing | 5.5 | 0.3 | 0.2 | - | - | - | - | 6 |
| Import/Repackage | 7.3 | 4.2 | 11.7 | 1.8 | 0.5 | 0.5 | - | 26 |
| Processing as a reactant | 21.4 | 3.5 | 7.4 | 1.4 | 0.7 | 0.7 | - | 35 |
| Incorporation Into Formulation, Mixture, or Reaction Product | - | - | 18.9 | 18.9 | 9.7 | 6.5 | - | 54 |
| Waste Handling, Disposal, Treatment, and Recycling | 621.9 | 130.9 | 272.8 | 32.7 | 10.9 | 21.8 | - | 1,091 |
| Laboratory Use | 20.7 | 9.0 | 21.8 | 2.8 | 1.1 | 0.6 | - | 56 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | - | - | - | - | - | 44.0 | - | 44 |
| Aerospace Paint and Coating Removers | - | - | - | - | - | 272.0 | - | 272 |
| Cellulose Triacetate Film Production | - | - | - | - | - | 1.0 | - | 1 |
| Furniture Refinishing | - | 49.0 | 2,106.6 | 1,469.7 | 734.9 | 538.9 | - | 4,899 |
| Glues, Sealants, Adhesives, and Caulks | 558.0 | 398.6 | 1,753.8 | 558.0 | 318.9 | 398.6 | - | 3,986 |

| Table 7‑48. Count of Employees, by Use Category, Worker Type, and Exposure Threshold | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Use Category | Employee Type | <Action Level | Between Action Level and Limit | < 10 times the ECEL | < 25 times the ECEL | < 50 times the ECEL | < 1,000 times the ECEL | < 10,000 times the ECEL | Total |
| Manufacturing | Worker | 490.4 | 26.7 | 16.0 | - | - | - | - | 533 |
| Import/Repackage | Worker | 164.4 | 93.9 | 264.2 | 41.1 | 11.7 | 11.7 | - | 587 |
| Processing as a reactant | Worker | 428.8 | 70.3 | 147.6 | 28.1 | 14.1 | 14.1 | - | 703 |
| Incorporation Into Formulation, Mixture, or Reaction Product | Worker | - | - | 108.5 | 108.5 | 55.8 | 37.2 | - | 310 |
| Waste Handling, Disposal, Treatment, and Recycling | Worker | 4271.0 | 899.2 | 1873.3 | 224.8 | 74.9 | 149.9 | - | 7,493 |
| Laboratory Use | Worker | 67.7 | 29.3 | 71.4 | 9.2 | 3.7 | 1.8 | - | 183 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Worker | - | - | - | - | - | 352.0 | - | 352 |
| Aerospace Paint and Coating Removers | Worker | - | - | - | - | - | 762.0 | - | 762 |
| Cellulose Triacetate Film Production | Worker | - | - | - | - | - | 5.0 | - | 5 |
| Furniture Refinishing | Worker | - | 116.3 | 4998.8 | 3487.5 | 1743.8 | 1278.8 | - | 11,625 |
| Glues, Sealants, Adhesives, and Caulks | Worker | 5720.7 | 4086.2 | 17979.3 | 5720.7 | 3269.0 | 4086.2 | - | 40,862 |

### Initial Exposure Monitoring and Periodic Exposure Monitoring

The initial exposure monitoring and periodic monitoring costs, presented in Table 7‑49, are based on the research and professional judgment of industrial hygiene firm, Environmental Health & Engineering, Inc. (EH&E). It is assumed that each potentially exposed worker and ONU is monitored during each exposure monitoring period. All facilities are assumed to conduct the initial exposure monitoring, while subsequent periodic exposure monitoring frequency was determined based on the ECEL threshold for each entity.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 7‑49. Summary of Costs Associated with an Exposure Evaluation of Methylene Chloride at a Simple Worksite (10 workers sampled) | | | | |
| Category | Sub-category | Unit Cost | Quantity | Total\* |
| Laboratory Analysis | Methylene chloride: Media | $49 | 1 unit | $50 |
| Methylene chloride: Analysis | $81 | 13 units | $1,055 |
| Equipment | Personal Pumps | $38 | 11 units | $420 |
| Calibration Meter | $54 | 1 unit | $55 |
| Tubing | $32 | 1 unit | $30 |
| Other Direct Costs (ODCs) | Shipping | $108 | 1 unit | $110 |
| Labor | Certified Industrial Hygienist (CIH) – sample planning and technical oversight | $71 | 4 hours | $285 |
| Technical Specialist – preparation and sample management | $50 | 2 hours | $100 |
| Technical Specialist – field data collection | $50 | 10 hours | $500 |
| Technical Specialist – report preparation | $50 | 8 hours | $400 |
| **Total** | | | | **$3,005** |
| \* Rounded to nearest $5. | | | | |

Since some of the per-facility costs presented above in Table 7‑49 can be expected to vary according to the number of workers that will require monitoring and those who will not, EPA re-categorized those monitoring costs that are expected to vary with the number of workers. Table 7‑50 presents the re-categorized estimates together with the per facility costs.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 7‑50. Summary of Per Facility and Per Employee Costs Associated with an Exposure Evaluation of Methylene Chloride | | | | | |
| Category | Sub-category | Rate | Quantity | Per-Facility Costs | Per-Employee Costs |
| Laboratory Analysis | Methylene chloride: Media | $45 | 1 unit | $50 | - |
| Methylene chloride: Analysis | $75 | 13 units | - | $106 |
| Equipment | Personal Pumps | $35 | 11 units | - | $42 |
| Calibration Meter | $50 | 1 unit | - | $6 |
| Tubing | $30 | 1 unit | $30 | - |
| Other Direct Costs (ODCs) | Shipping | $100 | 1 unit | - | $11 |
| Labor | Certified Industrial Hygienist – sample planning and technical oversight | $67 | 4 hours | $143 | $14 |
| Technical Specialist – preparation and sample management | $48 | 2 hours | - | $10 |
| Technical Specialist – field data collection | $48 | 10 hours | - | $50 |
| Technical Specialist – report preparation | $48 | 8 hours | $200 | $20 |
| **Total** | | | | **$423** | **$258** |

The per facility costs from Table 7‑50 are presented in Table 7‑51 and the per worker costs from Table 7‑50 are presented in Table 7‑52. Table 7‑51 and Table 7‑52 both present the costs for each threshold.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 7‑51. Per Facility Monitoring Costs (2022$) | | | | |
| Threshold | Cost Incurred | | | |
| Initial Monitoring Costs | Periodic Monitoring Costs | Initial Costs | Annual Costs |
| <Action Level | $258 | $258 every 5 years | $258 | $52 |
| Between Action Level and Limit | - | $517= $258 × 2 | - | $517 |
| < 10 times the ECEL | - | $1,033= $258 × 4 | - | $1,033 |
| < 25 times the ECEL | - | $1,033= $258 × 4 | - | $1,033 |
| < 50 times the ECEL | - | $1,033= $258 × 4 | - | $1,033 |
| < 1,000 times the ECEL | - | $1,033= $258 × 4 | - | $1,033 |
| < 10,000 times the ECE | - | $1,033= $258 × 4 | - | $1,033 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 7‑52. Per Worker Monitoring Costs (2022$) | | | | |
| Threshold | Cost Incurred | | | |
| Initial Monitoring Costs | Periodic Monitoring Costs | Initial Costs | Annual Costs |
| <Action Level | $423 | $423 every 5 years | $423 | $85 |
| Between Action Level and Limit | - | $846= $423 × 2 | - | $846 |
| < 10 times the ECEL | - | $1,692= $423 × 4 | - | $1,692 |
| < 25 times the ECEL | - | $1,692= $423 × 4 | - | $1,692 |
| < 50 times the ECEL | - | $1,692= $423 × 4 | - | $1,692 |
| < 1,000 times the ECEL | - | $1,692= $423 × 4 | - | $1,692 |
| < 10,000 times the ECEL | - | $1,692= $423 × 4 | - | $1,692 |

### Notifications and Recordkeeping

EPA developed the cost estimate for the notifications and recordkeeping burden for WCPPs from OSHA’s Final Economic Analysis and Final Regulatory Flexibility Analysis for Occupational Exposure to Respirable Crystalline Silica ([OSHA 2016b](#_ENREF_49)). That document included a recordkeeping burden for program development and associated recordkeeping, program updates and associated recordkeeping, and exposure monitoring recordkeeping and notifications.

OSHA ([2016b](#_ENREF_49)) assumed that a human resources manager will be responsible for program development and recordkeeping. OSHA estimated that it will take 4 hours for small employers (those with fewer than 20 employees) and medium employers (those with between 20 and 499 employees) and 8 hours for large employers (those with 500 or more employees) to develop the program and provide the appropriate recordkeeping. In addition, OSHA estimated that it will take half as much time (2 hours for small and medium employers and 4 hours for large employers) to review and update the plan (including appropriate recordkeeping), and that 20 percent of establishments will do so in any given year. OSHA estimated that it will take a human resources manager 15 minutes per sample (*i.e.*, per employee being monitored) to provide the required recordkeeping for exposure monitoring, which includes recording the sampling results and notifying the employee of the sampling results.

The per facility costs are presented in Table 7‑53. The per worker costs for each threshold are presented in Table 7‑54.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 7‑53. Per Facility Notification and Recordkeeping Costs | | | | |
| Threshold | Cost Incurred | | | |
| Setting up WCPP program and associated recordkeeping1 | Updating WCPP program and associated recordkeeping2 | Initial Costs | Annual Costs |
| All Thresholds | $285.28 | $28.53 | $285.28 | $28.53 |
| 1 Estimated as 4 hours of labor with the fully loaded managerial wage rate for manufacturing industry ($93.18).  2 Estimated as 2 hours of labor with the fully loaded managerial wage rate for manufacturing industry ($93.18) and adjusted by 20% to account for 20% of facilities updating records each year. | | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| Table 7‑54. Per Worker Notification and Recordkeeping Costs | | | |
| Threshold | Cost Incurred | | |
| Exposure monitoring notifications and recordkeeping | Initial Costs | Annual Costs |
| <Action Level | $3.57 = 1 sample periods\*$3.57 every five years | $17.83 | $3.57 |
| Between Action Level and ECEL | $35.66 = 2 sample periods\*$17.83 every five years | - | $35.66 |
| 1 to <10 times the ECEL | $71.32 = 4 sample periods\*$17.83 every five years | - | $71.32 |
| 10 to <25 times the ECEL | $71.32 = 4 sample periods\*$17.83 every five years | - | $71.32 |
| 25 to <50 times the ECEL | $71.32 = 4 sample periods\*$17.83 every five years | - | $71.32 |
| 50 to <1,000 times the ECEL | $71.32 = 4 sample periods\*$17.83 every five years | - | $71.32 |
| 1,000 to <10,000 times the ECEL | $71.32 = 4 sample periods\*$17.83 every five years | - | $71.32 |

### Respiratory Personal Protective Equipment (PPE)

The respirator PPE costs are estimated for respirators that use supplied air (*i.e.*, filter cartridges are not sufficiently protective). EPA assumed that all workers or ONUs in facilities at the following monitoring thresholds would wear the minimum required APF, unless they are already using PPE that is more protective. For workers that are using a higher APF than required, it is assumed that workers continue using the same PPE and therefore do not incur incremental costs.

* Less than ECEL: No respiratory protection
* Between ECEL and <10 times the ECEL: APF 10 supplied air respirator
* 10 to <25 times the ECEL: APF 25 supplied air respirator
* 25 to <50 times the ECEL: APF 50 supplied air respirator
* 50 to <1,000 times the ECEL: APF 1000 supplied air respirator
* 1,000 to <10,000 times the ECEL: APF 10000 supplied air respirator

As noted in Appendix C, supplied air respirators with an APF of 10 do not appear to be available, so they are not included in the analysis ([Abt Associates 2023a](#_ENREF_3)). Instead, it is assumed that facilities with exposure monitoring results requiring PPE with APF 10 will use an APF 25 supplied air respirator to comply with WCPP requirements. Total respiratory PPE costs are estimated by multiplying the number of workers and ONUs at each monitoring threshold (see Table 7‑47 and Table 7‑48) by the unit cost for the corresponding PPE required at that threshold. The estimates account for baseline usage of PPE in the industries expected to be affected by the requirements. See Appendix C ([Abt Associates 2023a](#_ENREF_3)) for a detailed description of how the PPE costs were estimated.

The total estimated costs by use category are presented in Table 7‑55.

| Table 7‑55. PPE Costs per Worker or ONU by Sector | | | |
| --- | --- | --- | --- |
| Sector (Use Categories) | APF | Average PPE Cost per Worker, Supplied Air Only | |
| Initial | Recurring |
| Manufacturing (Manufacturing, Import/Repackage, Processing as a Reactant, Incorporation Into Formulation, Mixture, or Reaction Product, Laboratory Use, Processing Aid, Plastics Manufacturing, and Solvent Welding, Aerospace Paint and Coating Removers, Cellulose Triacetate Film Production, Glues, Sealants, Adhesives, and Caulks) | 10 | $1,371 | $803 |
| 25 | $1,371 | $803 |
| 50 | $1,344 | $903 |
| 1,000 | $1,468 | $939 |
| 10,000 | $8,490 | $1,790 |
| Transportation and Public Utilities (Waste Handling, Disposal, Treatment, and Recycling) | 10 | $1,778 | $1,205 |
| 25 | $1,778 | $1,205 |
| 50 | $1,746 | $1,355 |
| 1,000 | $1,899 | $1,402 |
| 10,000 | $9,001 | $2,503 |
| Services (Furniture Refinishing) | 10 | $1,942 | $1,228 |
| 25 | $1,942 | $1,228 |
| 50 | $1,908 | $1,379 |
| 1,000 | $2,073 | $1,429 |
| 10,000 | $9,197 | $2,560 |

### Total Costs for Compliance with Monitoring and Respiratory Protection Requirements

Table 7‑56 and Table 7‑57 present the per worker and per facility costs, respectively, for complying with exposure monitoring, recordkeeping, and respiratory protection requirements by sector, use category, and monitoring threshold.

| Table 7‑56 Summary of Per Worker Respiratory WCPP Costs, by Threshold and Sector | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sector (Use Categories) | Threshold | Initial Costs | | | Recurring Costs | | | |
| Monitoring | Respiratory PPE | Total | Monitoring | Notification and Record-keeping | Respiratory PPE | Total |
| Manufacturing (Manufacturing, Import/Repackage, Processing as a Reactant, Incorporation Into Formulation, Mixture, or Reaction Product, Laboratory Use, Processing Aid, Plastics Manufacturing, and Solvent Welding, Aerospace Paint and Coating Removers, Cellulose Triacetate Film Production, Glues, Sealants, Adhesives, and Caulks) | <Action Level | $258 | - | $258 | $52 | $4 | - | $55 |
| Between Action Level and ECEL | - | - | - | $517 | $36 | - | $552 |
| 1 to <10 times the ECEL | - | $1,371 | $1,371 | $1,033 | $71 | $803 | $1,908 |
| 10 to <25 times the ECEL | - | $1,371 | $1,371 | $1,033 | $71 | $803 | $1,908 |
| 25 to <50 times the ECEL | - | $1,344 | $1,344 | $1,033 | $71 | $903 | $2,008 |
| 50 to <1,000 times the ECEL | - | $1,468 | $1,468 | $1,033 | $71 | $939 | $2,044 |
| 1,000 to < 10,000 times the ECEL | - | $8,490 | $8,490 | $1,033 | $71 | $1,790 | $2,895 |
| Transportation and Public Utilities (Waste Handling, Disposal, Treatment, and Recycling) | <Action Level | $258 | - | $258 | $52 | $4 | - | $55 |
| Between Action Level and ECEL | - | - | - | $517 | $36 | - | $552 |
| 1 to <10 times the ECEL | - | $1,778 | $1,778 | $1,033 | $71 | $1,205 | $2,310 |
| 10 to <25 times the ECEL | - | $1,778 | $1,778 | $1,033 | $71 | $1,205 | $2,310 |
| 25 to <50 times the ECEL | - | $1,746 | $1,746 | $1,033 | $71 | $1,355 | $2,460 |
| 50 to <1,000 times the ECEL | - | $1,899 | $1,899 | $1,033 | $71 | $1,402 | $2,506 |
| 1,000 to < 10,000 times the ECEL | - | $9,001 | $9,001 | $1,033 | $71 | $2,503 | $3,608 |
| Services (Furniture Refinishing) | <Action Level | $258 | - | $258 | $52 | $4 | - | $55 |
| Between Action Level and ECEL | - | - | - | $517 | $36 | - | $552 |
| 1 to <10 times the ECEL | - | $1,942 | $1,942 | $1,033 | $71 | $1,228 | $2,333 |
| 10 to <25 times the ECEL | - | $1,942 | $1,942 | $1,033 | $71 | $1,228 | $2,333 |
| 25 to <50 times the ECEL | - | $1,908 | $1,908 | $1,033 | $71 | $1,379 | $2,484 |
| 50 to <1,000 times the ECEL | - | $2,073 | $2,073 | $1,033 | $71 | $1,429 | $2,534 |
| 1,000 to < 10,000 times the ECEL | - | $9,197 | $9,197 | $1,033 | $71 | $2,560 | $3,664 |

| Table 7‑57: Summary of Per Facility Respiratory WCPP Costs, by Threshold | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Threshold | **Initial Costs** | | | **Recurring Costs** | | |
| Monitoring | Notification and Record-keeping | Total  Per Facility | Monitoring | Notification and Record-keeping | Total Per Facility |
| <Action Level | $423.00 | $285.28 | $708.28 | $84.60 | $28.53 | $113.13 |
| Between Action Level and ECEL | - | $285.28 | $285.28 | $846.00 | $28.53 | $874.53 |
| 1 to <10 times the ECEL | - | $285.28 | $285.28 | $1,692.00 | $28.53 | $1,720.53 |
| 10 to <25 times the ECEL | - | $285.28 | $285.28 | $1,692.00 | $28.53 | $1,720.53 |
| 25 to <50 times the ECEL | - | $285.28 | $285.28 | $1,692.00 | $28.53 | $1,720.53 |
| 50 to <1,000 times the ECEL | - | $285.28 | $285.28 | $1,692.00 | $28.53 | $1,720.53 |
| 1,000 to < 10,000 times the ECEL | - | $285.28 | $285.28 | $1,692.00 | $28.53 | $1,720.53 |

Table 7‑58 presents the total costs of compliance with the WCPP respiratory requirements by use category and threshold.

| Table 7‑58: Total Respiratory WCPP Costs by Threshold and Use Category (2022$) | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Use Category | Threshold | Facilities | Workers/  ONUs | Per Facility Costs | | Per Worker/ONU Costs | | Total Costs | |
| Initial | Annual | Initial | Recurring | Initial | Recurring |
| Manufacturing | <Action Level | 5.5 | 490.4 | $708.28 | $113.13 | $258.36 | $55.24 | $130,599 | $27,711 |
| Between Action Level and ECEL | 0.3 | 26.7 | $285.28 | $874.53 | - | $552.38 | $86 | $14,983 |
| 1 to <10 times the ECEL | 0.2 | 16.0 | $285.28 | $1,720.53 | $1,370.58 | $1,908.17 | $21,967 | $30,821 |
| 10 to <25 times the ECEL | - | - | - | - | - | - | - | - |
| 25 to <50 times the ECEL | - | - | - | - | - | - | - | - |
| 50 to <1,000 times the ECEL | - | - | - | - | - | - | - | - |
| 1,000 to < 10,000 times the ECEL | - | - | - | - | - | - | - | - |
| **All thresholds** | **6.0** | **533.0** | **$674.44** | **$199.42** | **$278.81** | **$135.68** | **$152,652** | **$73,516** |
| Import/Repackage | <Action Level | 7.3 | 164.4 | $708.28 | $113.13 | $258.36 | $55.24 | $47,620 | $9,903 |
| Between Action Level and ECEL | 4.2 | 93.9 | $285.28 | $874.53 | - | $552.38 | $1,187 | $55,518 |
| 1 to <10 times the ECEL | 11.7 | 264.2 | $285.28 | $1,720.53 | $1,370.58 | $1,908.17 | $365,375 | $524,173 |
| 10 to <25 times the ECEL | 1.8 | 41.1 | $285.28 | $1,720.53 | $1,370.58 | $1,908.17 | $56,836 | $81,538 |
| 25 to <50 times the ECEL | 0.5 | 11.7 | $285.28 | $1,720.53 | $1,344.34 | $2,008.10 | $15,931 | $24,470 |
| 50 to <1,000 times the ECEL | 0.5 | 11.7 | $285.28 | $1,720.53 | $1,467.74 | $2,044.00 | $17,380 | $24,891 |
| 1,000 to < 10,000 times the ECEL | - | - | - | - | - | - | - | - |
| **All thresholds** | **26.0** | **587.0** | **$403.72** | **$1,135.10** | **$841.28** | **$1,177.14** | **$504,329** | **$720,492** |
| Processing as a reactant | <Action Level | 21.4 | 428.8 | $708.28 | $113.13 | $258.36 | $55.24 | $125,914 | $26,103 |
| Between Action Level and ECEL | 3.5 | 70.3 | $285.28 | $874.53 | - | $552.38 | $998 | $41,893 |
| 1 to <10 times the ECEL | 7.4 | 147.6 | $285.28 | $1,720.53 | $1,370.58 | $1,908.17 | $204,435 | $294,349 |
| 10 to <25 times the ECEL | 1.4 | 28.1 | $285.28 | $1,720.53 | $1,370.58 | $1,908.17 | $38,940 | $56,066 |
| 25 to <50 times the ECEL | 0.7 | 14.1 | $285.28 | $1,720.53 | $1,344.34 | $2,008.10 | $19,101 | $29,438 |
| 50 to <1,000 times the ECEL | 0.7 | 14.1 | $285.28 | $1,720.53 | $1,467.74 | $2,044.00 | $20,836 | $29,943 |
| 1,000 to < 10,000 times the ECEL | - | - | - | - | - | - | - | - |
| **All thresholds** | **35.0** | **703.0** | **$543.31** | **$655.42** | **$556.49** | **$647.02** | **$410,225** | **$477,793** |
| Incorporation Into Formulation, Mixture, or Reaction Product | <Action Level | - | - | $708.28 | $113.13 | $258.36 | $55.24 | - | - |
| Between Action Level and ECEL | - | - | $285.28 | $874.53 | - | $552.38 | - | - |
| 1 to <10 times the ECEL | 18.9 | 108.5 | $285.28 | $1,720.53 | $1,370.58 | $1,908.17 | $154,099 | $239,554 |
| 10 to <25 times the ECEL | 18.9 | 108.5 | $285.28 | $1,720.53 | $1,370.58 | $1,908.17 | $154,099 | $239,554 |
| 25 to <50 times the ECEL | 9.7 | 55.8 | $285.28 | $1,720.53 | $1,344.34 | $2,008.10 | $77,787 | $128,776 |
| 50 to <1,000 times the ECEL | 6.5 | 37.2 | $285.28 | $1,720.53 | $1,467.74 | $2,044.00 | $56,449 | $87,186 |
| 1,000 to < 10,000 times the ECEL | - | - | - | - | - | - | - | - |
| **All thresholds** | **54.0** | **310.0** | **$285.28** | **$1,720.53** | **$1,377.51** | **$1,942.46** | **$442,434** | **$695,070** |
| Waste Handling, Disposal, Treatment, and Recycling | <Action Level | 621.9 | 4,271.0 | $708.28 | $113.13 | $258.36 | $55.24 | $1,543,913 | $306,274 |
| Between Action Level and ECEL | 130.9 | 899.2 | $285.28 | $874.53 | - | $552.38 | $37,348 | $611,171 |
| 1 to <10 times the ECEL | 272.8 | 1,873.3 | $285.28 | $1,720.53 | $1,777.88 | $2,309.71 | $3,408,216 | $4,795,940 |
| 10 to <25 times the ECEL | 32.7 | 224.8 | $285.28 | $1,720.53 | $1,777.88 | $2,309.71 | $408,986 | $575,513 |
| 25 to <50 times the ECEL | 10.9 | 74.9 | $285.28 | $1,720.53 | $1,745.61 | $2,460.00 | $133,911 | $203,099 |
| 50 to <1,000 times the ECEL | 21.8 | 149.9 | $285.28 | $1,720.53 | $1,899.23 | $2,506.48 | $290,843 | $413,163 |
| 1,000 to < 10,000 times the ECEL | - | - | - | - | - | - | - | - |
| **All thresholds** | **1,091.0** | **7,493.0** | **$526.39** | **$702.79** | **$700.51** | **$819.22** | **$5,823,217** | **$6,905,160** |
| Laboratory Use | <Action Level | 20.7 | 67.7 | $708.28 | $113.13 | $258.36 | $55.24 | $32,169 | $6,084 |
| Between Action Level and ECEL | 9.0 | 29.3 | $285.28 | $874.53 | - | $552.38 | $2,556 | $24,009 |
| 1 to <10 times the ECEL | 21.8 | 71.4 | $285.28 | $1,720.53 | $1,370.58 | $1,908.17 | $104,048 | $173,762 |
| 10 to <25 times the ECEL | 2.8 | 9.2 | $285.28 | $1,720.53 | $1,370.58 | $1,908.17 | $13,340 | $22,277 |
| 25 to <50 times the ECEL | 1.1 | 3.7 | $285.28 | $1,720.53 | $1,344.34 | $2,008.10 | $5,240 | $9,277 |
| 50 to <1,000 times the ECEL | 0.6 | 1.8 | $285.28 | $1,720.53 | $1,467.74 | $2,044.00 | $2,846 | $4,704 |
| 1,000 to < 10,000 times the ECEL | - | - | - | - | - | - | - | - |
| **All thresholds** | **56.0** | **183.0** | **$441.79** | **$990.43** | **$740.21** | **$1,009.01** | **$160,199** | **$240,114** |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | <Action Level | - | - | $708.28 | $113.13 | $258.36 | $55.24 | - | - |
| Between Action Level and ECEL | - | - | $285.28 | $874.53 | - | $552.38 | - | - |
| 1 to <10 times the ECEL | - | - | $285.28 | $1,720.53 | $1,370.58 | $1,908.17 | - | - |
| 10 to <25 times the ECEL | - | - | - | - | - | - | - | - |
| 25 to <50 times the ECEL | - | - | - | - | - | - | - | - |
| 50 to <1,000 times the ECEL | 44.0 | 352.0 | $285.28 | $1,720.53 | $1,467.74 | $2,044.00 | $529,197 | $795,190 |
| 1,000 to < 10,000 times the ECEL | - | - | - | - | - | - | - | - |
| **All thresholds** | **44.0** | **352.0** | **$285.28** | **$1,720.53** | **$1,467.74** | **$2,044.00** | **$529,197** | **$795,190** |
| Aerospace Paint and Coating Removers | <Action Level | - | - | $708.28 | $113.13 | $258.36 | $55.24 | - | - |
| Between Action Level and ECEL | - | - | $285.28 | $874.53 | - | $552.38 | - | - |
| 1 to <10 times the ECEL | - | - | $285.28 | $1,720.53 | $1,370.58 | $1,908.17 | - | - |
| 10 to <25 times the ECEL | - | - | - | - | - | - | - | - |
| 25 to <50 times the ECEL | - | - | - | - | - | - | - | - |
| 50 to <1,000 times the ECEL | 272.0 | 762.0 | $285.28 | $1,720.53 | $1,467.74 | $2,044.00 | $1,196,013 | $2,025,509 |
| 1,000 to < 10,000 times the ECEL | - | - | - | - | - | - | - | - |
| **All thresholds** | **272.0** | **762.0** | **$285.28** | **$1,720.53** | **$1,467.74** | **$2,044.00** | **$1,196,013** | **$2,025,509** |
| Cellulose Triacetate Film Production | <Action Level | - | - | $708.28 | $113.13 | $258.36 | $55.24 | - | - |
| Between Action Level and ECEL | - | - | $285.28 | $874.53 | - | $552.38 | - | - |
| 1 to <10 times the ECEL | - | - | $285.28 | $1,720.53 | $1,370.58 | $1,908.17 | - | - |
| 10 to <25 times the ECEL | - | - | - | - | - | - | - | - |
| 25 to <50 times the ECEL | - | - | - | - | - | - | - | - |
| 50 to <1,000 times the ECEL | 1.0 | 5.0 | $285.28 | $1,720.53 | $1,467.74 | $2,044.00 | $7,624 | $11,941 |
| 1,000 to < 10,000 times the ECEL | - | - | - | - | - | - | - | - |
| **All thresholds** | **1.0** | **5.0** | **$285.28** | **$1,720.53** | **$1,467.74** | **$2,044.00** | **$7,624** | **$11,941** |
| Furniture Refinishing | <Action Level | - | - | $708.28 | $113.13 | $258.36 | $55.24 | - | - |
| Between Action Level and ECEL | 49.0 | 116.3 | $285.28 | $874.53 | - | $552.38 | $13,976 | $107,057 |
| 1 to <10 times the ECEL | 2,106.6 | 4,998.8 | $285.28 | $1,720.53 | $1,942.27 | $2,332.99 | $10,309,895 | $15,286,474 |
| 10 to <25 times the ECEL | 1,469.7 | 3,487.5 | $285.28 | $1,720.53 | $1,942.27 | $2,332.99 | $7,192,950 | $10,664,982 |
| 25 to <50 times the ECEL | 734.9 | 1,743.8 | $285.28 | $1,720.53 | $1,907.60 | $2,483.53 | $3,536,020 | $5,594,981 |
| 50 to <1,000 times the ECEL | 538.9 | 1,278.8 | $285.28 | $1,720.53 | $2,073.26 | $2,534.20 | $2,804,917 | $4,167,785 |
| 1,000 to < 10,000 times the ECEL | - | - | - | - | - | - | - | - |
| **All thresholds** | **4,899.0** | **11,625.0** | **$285.28** | **$1,712.07** | **$1,932.06** | **$2,359.90** | **$23,857,757** | **$35,821,279** |
| Glues, Sealants, Adhesives, and Caulks | <Action Level | 558.0 | 5,720.7 | $708.28 | $113.13 | $258.36 | $55.24 | $1,873,241 | $379,130 |
| Between Action Level and ECEL | 398.6 | 4,086.2 | $285.28 | $874.53 | - | $552.38 | $113,711 | $2,605,723 |
| 1 to <10 times the ECEL | 1,753.8 | 17,979.3 | $285.28 | $1,720.53 | $1,370.58 | $1,908.17 | $25,142,290 | $37,325,018 |
| 10 to <25 times the ECEL | 558.0 | 5,720.7 | $285.28 | $1,720.53 | $1,370.58 | $1,908.17 | $7,999,820 | $11,876,142 |
| 25 to <50 times the ECEL | 318.9 | 3,269.0 | $285.28 | $1,720.53 | $1,344.34 | $2,008.10 | $4,485,557 | $7,113,045 |
| 50 to <1,000 times the ECEL | 398.6 | 4,086.2 | $285.28 | $1,720.53 | $1,467.74 | $2,044.00 | $6,111,189 | $9,037,981 |
| 1,000 to < 10,000 times the ECEL | - | - | - | - | - | - | - | - |
| **All thresholds** | **3,986.0** | **40,862.0** | **$344.50** | **$1,410.89** | **$1,085.43** | **$1,534.76** | **$45,725,807** | **$68,337,039** |

## Total WCPP Costs

Table 7‑59 presents the total costs of compliance with the WCPP dermal (see section 7.9) and respiratory (see section 7.10) requirements by use category.

| Table 7‑59: Total WCPP Costs (Dermal and Respiratory) by Use Category (2022$) | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Use Category** | **Facilities** | **Workers/ONUs** | **Per Facility Costs** | | **Per Worker/ONU Costs** | | **Total Costs** | |
| **Initial** | **Annual** | **Initial** | **Recurring** | **Initial** | **Recurring** |
| Manufacturing | 6 | 533 | $1,031.04 | $199.42 | $278.81 | $395.83 | $154,791 | $212,171 |
| Import/Repackage | 26 | 587 | $760.32 | $1,135.10 | $841.28 | $1,437.28 | $513,601 | $873,195 |
| Processing as a reactant | 35 | 703 | $899.91 | $655.42 | $556.49 | $907.16 | $422,706 | $660,672 |
| Incorporation Into Formulation, Mixture, or Reaction Product | 54 | 310 | $641.88 | $1,720.53 | $1,377.51 | $2,202.60 | $461,690 | $775,714 |
| Waste Handling, Disposal, Treatment, and Recycling | 1,091 | 7,493 | $882.99 | $702.79 | $700.51 | $1,094.90 | $6,212,268 | $8,970,845 |
| Laboratory Use | 56 | 183 | $798.39 | $990.43 | $740.21 | $1,269.16 | $180,168 | $287,720 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | 44 | 352 | $641.88 | $1,720.53 | $1,467.74 | $2,304.14 | $544,887 | $886,760 |
| Aerospace Paint and Coating Removers | 272 | 762 | $641.88 | $1,720.53 | $1,467.74 | $2,304.14 | $1,293,008 | $2,223,738 |
| Cellulose Triacetate Film Production | 1 | 5 | $641.88 | $1,720.53 | $1,382.39 | $2,216.32 | $7,554 | $12,802 |
| Furniture Refinishing | 4,899 | 11,625 | $641.88 | $1,720.53 | $1,382.39 | $2,226.06 | $19,214,794 | $34,306,867 |
| Glues, Sealants, Adhesives, and Caulks | 3,986 | 40,862 | $661.97 | $1,603.99 | $1,265.24 | $2,050.11 | $54,339,019 | $90,165,105 |

## APF 50 Respirator Protection for Furniture Refinishing

Furniture refinishers have the option to have potentially exposed persons to use APF 50 respirators during the 5 year period preceding the prohibition instead of complying with WCPP requirements under Option 1. In this economic analysis, EPA assumes that furniture refinishers choose this compliance strategy under option 1.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 7‑60. Costs of APF 50 Respirators for Furniture Refinishing Under Option 1 (2022$) | | | | |
| Number of workers | Costs Per Worker | | Total Costs | |
| Initial Costs | Annual Costs | Initial Costs | Annual Costs |
| 11,625 | $1,908 | $1,379 | $22,175,901 | $16,028,163 |

## Unquantified Costs and Uncertainty in the Cost Estimates

This economic analysis does not include quantified cost estimates for all costs under the options. Although certain costs cannot be quantified, this does not necessarily mean that they are less important than the quantified costs. This section discusses these unquantified costs qualitatively as well as other uncertainties in the cost estimates.

### Technological Innovation and Compliance

As noted in *EPA Guidelines for Preparing Economic Analyses* ([EPA 2014a](#_ENREF_86)), undiscovered technological innovation is often considered to be one reason why regulatory costs are overstated ([Harrington, Morgenstern et al. 1999](#_ENREF_23)). The cost estimates in this economic analysis do not reflect any assumption about technological innovations that could lower compliance costs. Costs (and benefits) are estimated assuming full compliance with the rule’s requirements, and therefore would be lower if full compliance with the rule’s requirements is not achieved.

### Impacts of Prohibition of Methylene Chloride Use for Furniture Refinishing

Furniture refinishers offer a service of stripping and refinishing items brought in by consumers or possibly also by businesses. Most items stripped by furniture refinishers are made of wood, but occasionally they may take in items made of metal (*e.g.,* metal patio furniture) ([Wolf 2015](#_ENREF_115)). There is a variety of work performed by these firms which includes paint and coating removal, refinishing, repair, and reupholstery. The extent to which each firm relies on the use of methylene chloride (*e.g.,* work that requires paint and coating removal versus reupholstery) is currently unknown.

Refinishers are generally small firms with one to five employees although there may be some shops that are larger and fall into two general types. First, some refinishers do a high volume of work and use equipment for stripping. Second, other refinishers, who may specialize in antiques and restoration for instance, use very small volumes of stripper and so do not use stripping equipment. Such businesses are often one to two person operations ([Wolf 2015](#_ENREF_115)).

During furniture paint and coating removal, a paint or coating remover may be applied to a piece of furniture by either dipping the furniture into a dip tank, or manually via brushing or spraying ([EPA 2014b](#_ENREF_87)). Once the remover has been applied, the solvent is allowed to soften the paint or coating and then is removed by hand brushing or scraping ([UK Heath and Safety Executive 2001](#_ENREF_112)). After the scraping, the furniture is then transferred to a washing area, where the residual paint and solvents are removed from the furniture, through low-pressure washing, high-pressure water jets or high pressure wands ([EPA 2014b](#_ENREF_87)). The vast majority of furniture paint and coating removal is done by chemical removers, because they are quick and effective and will not damage antiques and fragile pieces as sanding, caustic removers, and heat guns may ([Abt Associates 2015](#_ENREF_2); [Wolf 2015](#_ENREF_115)). Of the chemical removers, methylene chloride is preferred because of its minimal wait time and its effectiveness ([Abt Associates 2015](#_ENREF_2)). A TURI ([2020](#_ENREF_68)) assessment of paint remover alternatives found that some safer alternatives (defined by TURI as formulations with no Greenscreen Benchmark 1 chemicals) were as effective as the available methylene chloride paint removers. However, while the TURI results were encouraging, it is uncertain whether the alternatives are effective on all coatings and substrates. Because of these potential challenges, the final regulation allows for 5 years of continued use of methylene chloride with additional worker protections during this interim period. The agency believes that this deferment of the prohibition of methylene chloride use for furniture refinishing will allow the affected firms to identify technologically and economically feasible alternatives.

However, furniture refinishing costs may increase if available alternatives increase labor and costs of performing the work and it is possible that some affected firms may ultimately discontinue this service as a result. Other firms may raise their prices for furniture refinishing as their costs increase. There would be a social cost equal to the loss of producer and consumer surplus due to the increased costs for furniture refinishing. In order to quantify this social cost, EPA would need to know the increase in price, the elasticity of demand, and the marginal costs. Since sufficient data are not available to develop these estimates, they are not quantified in the economic analysis.

It is possible to estimate that profits for the 4,899 furniture refinishing firms that use methylene chloride are approximately $63 million using the average estimated revenues per firm for NAICS 811420, Reupholstery and Furniture Repair ($338,525 is average revenue, calculated using the estimates presented in Table 3‑1) and an IRS ([2013](#_ENREF_28)) estimate for profit in this sector of 3.8% of sales. Profit is related to, but not the same as producer surplus. Producer surplus is generally larger than profit since producer surplus is the difference between total revenue and marginal cost and profit is the difference between total revenue and total cost. Total revenue for the 4,899 furniture refinishing firms that use methylene chloride is estimated to be $1.7 billion. Total revenue provides a measure of overall economic activity for these firms, but does not directly relate to the potential loss of producer surplus from potential closures or price increases in the furniture refinishing industry.

EPA does not have the detailed financial data to estimate how this rule would affect the probability of increased rates of firm closure in this sector as a result of prohibiting the use of methylene chloride in paint and coating removal after 5 years. While the number of additional closures could be greater than zero, it is unlikely to approach a complete sector closure of all 4,899 firms. Table 7‑61 shows the potential lost revenue and profit in the furniture refinishing sector under varying assumptions of the number of firms which may close.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 7‑61: Estimated Revenue and Profit Losses for Furniture Refinishers by Assumed Percentage | | | |  |
| Percentage of Firms Closing | Number of Firms Closing | Revenue of Firms (2022$, Thousands) | Potential Profit Loss (2022$, Thousands) | |
| - | 1 | $339 | $13 | |
| 10 | 490 | $166,110 | $6,312 | |
| 25 | 1,225 | $415,275 | $15,780 | |
| 33 | 1,617 | $548,163 | $20,830 | |
| 50 | 2,450 | $830,550 | $31,561 | |
| 66 | 3,233 | $1,095,987 | $41,648 | |
| 75 | 3,674 | $1,245,486 | $47,328 | |
| 100 | 4,899 | $1,660,761 | $63,109 | |

### Products formulated with methylene chloride

The cost estimates for switching to alternatives to products formulated with methylene chloride include reformulation costs for each product that EPA identified. On the one hand, if there are additional products that EPA did not identify that need to be reformulated, these costs could be underestimated. On the other hand, many producers of these products already make methylene chloride-free alternative products, since the methylene chloride products are already prohibited in several states. Thus, the reformulation costs may be overstated to the extent to which producers use existing products to replace the methylene chloride products instead of reformulating.

As documented in chapter 3, alternative products with similar cost and efficacy are available for most of the products that are formulated with methylene chloride. For some applications, there may be additional unquantified costs associated with the alternatives. For the costs of the products themselves, in most cases there were both alternatives that were more costly and less costly, but it is unclear whether average product costs would be higher or lower after a prohibition of methylene chloride in these products. Potential changes in producer and consumer surplus are also possible (see Chapter 4 for a discussion).

For most product types, alternatives with similar efficacy are available. However, there may be some applications where methylene chloride is more effective, reducing labor time and wait time, and this analysis was unable to quantify these costs.

There may be other characteristics that were not identified in the use and alternatives analysis presented in chapter 5 that make methylene chloride a preferable choice even against alternatives with similar costs and effectiveness. EPA is uncertain about what these properties might be if they exist. Alternative products that are drop-in substitutes (i.e., requiring no changes by the user in how the product is used) were generally available. However, in some cases some effort might be required by firms using methylene chloride products to identify suitable alternatives, test them for their desired applications, learn how to use them safely and effectively, and implement new processes for using the alternative products. The information to estimate how often these costs might be incurred or what the specific costs would be per-user or per-firm when they are incurred is not available. As a result, any cost associated with loss of the ability to use methylene chloride is not quantifiable and is not included in the cost estimates.

### Finishing Products for Fabric, Textiles and Leather, Electrical Equipment, Appliance, and Component Manufacturing, Plastic and Rubber Manufacturing, and Oil and Gas Drilling

Four COUs are defined by the sectors using methylene chloride and not the way in which the methylene chloride is used. To the extent to which other COUs overlap with these, the uncertainties under the sector-defined COUs would be the same as for the other COUs with which they overlap. For example, EPA believes that the use of methylene chloride in the Electrical Equipment, Appliance, and Component Manufacturing sector is likely to be limited to cleaning and degreasing. However, if these sectors are using methylene chloride in other ways, the costs of switching to alternatives is unknown and therefore not estimated.

### WCPP Cost Estimate Uncertainties

As noted in section 7.10, the costs of WCPP compliance varies with how far above the ECEL a facility is according to the monitoring results. EPA estimated a distribution for air monitoring results, described in section 7.10, but since these data were not collected in the same way monitoring data under a WCPP would be collected, these estimated distributions are uncertain. The WCPP costs also assume that when the exposure levels exceed the ECEL compliance is achieved by implementing a respirator PPE program. However, the WCPP requires that feasible engineering and administrative controls are implemented before resorting to PPE use. These controls would need to be implemented even if they are more expensive than achieving compliance through a PPE program. However, since PPE programs are costly, achieving compliance through engineering and/or administrative controls may be less expensive than the estimated PPE costs.

There also may be some unquantified costs associated with implementing a respirator program. The WCPP requirements specify that only supplied air respirators (SARs) may be used as part of the PPE program under a WCPP. For these respirators the air is supplied either with a tank worn by the worker or through a hose that is attached to the air supply. Respirators have been found to interfere with many physiological and psychological aspects of task performance (Johnson 2016). The extent to which respirators might reduce worker productivity or necessitate offering higher wages to workers who must wear respirators is unknown and therefore unquantified in this analysis. The EPA costs of administering and enforcing a WCPP are also unquantified in this economic analysis.

### Implications of the unquantified costs and uncertain costs for comparing the costs of the options

The unquantified costs associated with products containing methylene chloride (see section 7.13.3) are the same across all options, since methylene chloride is prohibited for these uses in all options. For the COUs defined according to the sector of use (see section 7.13.4), the implication is that the cost savings of allowing for a WCPP compared to a prohibition requirement is uncertain. If these COUs overlap entirely with others, there may actually be no difference in costs for these COUs, since it might be easier to switch to alternative products than comply with WCPP requirements. However, if methylene chloride use is more critical in these COUs, the cost savings under a WCPP may be understated.

### Unknown and Unquantified Hazards of Alternatives

It is possible that there could be costs associated with hazards of methylene chloride alternatives. Such hazards could include exposure to known and unknown toxic substances that are used to replace methylene chloride or increases in other types of risk, such as fire associated with replacements. EPA has attempted to identify these potential hazards in its analysis of alternatives for specific uses and has generally identified potential replacements that do not raise these concerns. However, not knowing which replacement methylene chloride users will choose or what the probability of an adverse event associated with replacement might be, it is impossible to quantify and/or put a value of these potential countervailing effects.

## Total Annualized Costs

Table 7‑61 and Table 7‑62 present the total annualized costs for 3 and 7 percent discount rates, respectively. Note that the costs of prohibition for the Aerospace Paint and Coating Removers, and Cellulose Triacetate Film Production use categories are estimated using the WCPP costs as a proxy for the costs of prohibition. For furniture refinishing, the APF 50 respirator costs are used as a proxy for prohibition costs. These proxies are considered lower bound estimates. Since switching to alternatives is an available compliance strategy under the conditions of use with WCPP requirements (or respirator requirements), it is reasonable to assume that affected entities would simply switch to an alternative if it is less costly to switch compared to the costs of compliance with a WCPP.

|  |  |  |
| --- | --- | --- |
| Table 7‑61: Total 20-Year Annualized Costs by Use Category by Option (3% Discount Rate, 2022$) | | |
| Use Category | Option 1  (Final Rule) | Option 2  (Alternative Option) |
| Manufacturing | $208,710 | $208,710 |
| Import/Repackage | $851,208 | $851,208 |
| Processing as a reactant | $646,156 | $646,156 |
| Incorporation Into Formulation, Mixture, or Reaction Product | $98,086 | $98,086 |
| Waste Handling, Disposal, Treatment, and Recycling | $8,811,805 | $8,811,805 |
| Laboratory Use | $281,701 | $281,701 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | $865,821 | $166,273,554 |
| Aerospace Paint and Coating Removers | $2,169,359 | $2,169,359 |
| Cellulose Triacetate Film Production | $12,485 | $12,485 |
| Furniture Refinishing | $16,491,740 | $16,491,740 |
| Glues, Sealants, Adhesives, and Caulks | $236,910 | $318,387 |
| Vapor Degreasing | $4,223,532 | $4,223,532 |
| Liquid Cleaners and Degreasers | $55,177 | $55,177 |
| Aerosol Spray Cleaning/Degreasing | $1,057,880 | $1,057,880 |
| Paint and Coating Removers (Graffiti Removal) | $815 | $815 |
| Paint and Coating Removers (Bathtub Refinishing) | $3,384 | $3,384 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | $47,971 | $47,971 |
| Paint and Coating Removers (Art Restoration) | $309 | $309 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | $10,337 | $10,337 |
| Paint and Coating Removers (Professional Contracting) | $4,827 | $4,827 |
| Adhesive and Caulk Remover | $31,968 | $31,968 |
| Lithographic Printing Cleaner | $17,686 | $17,686 |
| Dry Cleaning and Spot Removers | $12,477 | $12,477 |
| Paint and Coatings | $504,014 | $504,014 |
| Lubricants and Greases | $140,607 | $140,607 |
| Cold Pipe Insulation | $64,473 | $64,473 |
| Anti-spatter Welding Aerosol | $97,130 | $97,130 |
| **Total** | **$36,946,566** | **$202,435,776** |

|  |  |  |
| --- | --- | --- |
| Table 7‑62: Total 20-Year Annualized Costs by Use Category by Option (7% Discount Rate, 2022$) | | |
| Use Category | Option 1  (Final Rule) | Option 2  (Alternative Option) |
| Manufacturing | $207,431 | $207,431 |
| Import/Repackage | $843,084 | $843,084 |
| Processing as a reactant | $640,793 | $640,793 |
| Incorporation Into Formulation, Mixture, or Reaction Product | $97,174 | $97,174 |
| Waste Handling, Disposal, Treatment, and Recycling | $8,753,047 | $8,753,047 |
| Laboratory Use | $279,477 | $279,477 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | $858,085 | $227,704,065 |
| Aerospace Paint and Coating Removers | $2,149,268 | $2,149,268 |
| Cellulose Triacetate Film Production | $12,368 | $12,368 |
| Furniture Refinishing | $16,663,010 | $16,663,010 |
| Glues, Sealants, Adhesives, and Caulks | $221,649 | $436,017 |
| Vapor Degreasing | $5,966,075 | $5,966,075 |
| Liquid Cleaners and Degreasers | $75,563 | $75,563 |
| Aerosol Spray Cleaning/Degreasing | $1,448,718 | $1,448,718 |
| Paint and Coating Removers (Graffiti Removal) | $1,116 | $1,116 |
| Paint and Coating Removers (Bathtub Refinishing) | $4,634 | $4,634 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | $65,694 | $65,694 |
| Paint and Coating Removers (Art Restoration) | $424 | $424 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | $14,156 | $14,156 |
| Paint and Coating Removers (Professional Contracting) | $6,611 | $6,611 |
| Adhesive and Caulk Remover | $43,778 | $43,778 |
| Lithographic Printing Cleaner | $24,220 | $24,220 |
| Dry Cleaning and Spot Removers | $17,086 | $17,086 |
| Paint and Coatings | $690,224 | $690,224 |
| Lubricants and Greases | $192,555 | $192,555 |
| Cold Pipe Insulation | $88,293 | $88,293 |
| Anti-spatter Welding Aerosol | $133,015 | $133,015 |
| **Total** | **$39,497,548** | **$266,557,895** |

# Benefits Analysis

This Chapter presents the monetized benefits estimates under the options and includes a discussion of unquantified non-cancer benefits. All monetized benefits estimates are presented in 2022$, unless otherwise noted. As described above in section 7.2, the timeline for the analysis is 20 years, and therefore the benefits of 20 years of reduced exposures under the regulatory options are annualized over the same period. Note that the benefits from a reduced exposure in any of the 20 years considered in the analysis may be realized more than 20 years after the rule becomes effective; these benefits are included in the analysis. Since the benefits in each year of reduced exposure risks are estimated to be the same, annualized benefits are not sensitive to the analysis timeframe.

The options are summarized in Section 8.1. Section 8.2 presents the estimated benefits from avoided mortality risk due to acute exposures. The cancer benefits estimates are described in section ‎8.3 through 8.8, following the approach outlined in Figure 8‑1. Section 8.9 discusses the non-cancer benefits that are not monetized in this economic analysis.

|  |
| --- |
| Figure 8‑1: Outline of Approach for Estimating Cancer Benefits |
|  |

## Summary of options considered

Table 8‑1 summarizes the options analyzed by use category.

| Table 8‑1: Summary of Options Analyzed by Use Category | | | |
| --- | --- | --- | --- |
| Use Category | Condition of Use (COU) | Option 1 | Option 2 |
| Manufacturing | Manufacturing (Domestic manufacturing) | WCPP | WCPP |
| Import/Repackage | Manufacturing (Import) |
| Processing: repackaging |
| Processing as a Reactant | Processing: processing as a reactant |
| Incorporation Into Formulation, Mixture, or Reaction Product | Processing: incorporation into a formulation, mixture, or reaction product |
| Industrial and commercial use as solvent that becomes part of a formulation or mixture |
| Waste Handling, Disposal, Treatment, and Recycling | Processing: recycling |
| Disposal |
| Laboratory Use | Industrial and commercial use as a laboratory chemical |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Industrial and commercial use as a processing aid | Prohibit |
| Industrial and commercial use as a solvent that becomes part of a formulation or mixture, where that formulation or mixture will be used inside a manufacturing process, and the solvent (methylene chloride) will be reclaimed |
| Industrial and commercial use for plastic and rubber products manufacturing |
| Industrial or commercial use as a bonding agent for solvent welding |
| Aerospace Paint and Coating Removers | Industrial and commercial use as a paint and coating remover from safety critical, corrosion-sensitive components of aircraft and spacecraft | Prohibit with a 10-year time-limited exemption and interim WCPP |
| Cellulose Triacetate Film Production | Industrial and commercial use in cellulose triacetate film production | Prohibit | WCPP |
| Furniture Refinishing | Industrial and commercial use in paint and coating removal in furniture refinishing for intricate or historically significant wood pieces | Prohibit after 5 years with interim worker protection requirements | Prohibit |
| Glues, Sealants, Adhesives, and Caulks | Industrial and commercial use in adhesives and sealants in aircraft, space vehicle, and turbine applications for structural and safety critical non-structural applications | Prohibit after 5 years | Prohibit |
| Industrial and commercial use in adhesives, sealants and caulks (except adhesives and sealants in aircraft, space vehicle, and turbine applications for structural and safety critical non-structural applications) | Prohibit | Prohibit |
| Consumer use in adhesives and sealants |
| Consumer use in arts, crafts, and hobby materials glue |
| Vapor Degreasing | Industrial and commercial use as solvent for batch vapor degreasing |
| Industrial and commercial use as solvent for in-line vapor degreasing |
| Liquid Cleaners and Degreasers | Industrial and commercial use as solvent for cold cleaning |
| Industrial and commercial use in metal non-aerosol degreasers |
| Industrial and commercial use in non-aerosol degreasers and cleaners |
| Aerosol Spray Cleaning/Degreasing | Industrial and commercial use as a solvent for aerosol spray degreaser/cleaner |
| Industrial and commercial use in metal aerosol degreasers |
| Industrial and commercial use in automotive care products (interior car care) |
| Industrial and commercial use in automotive care products (degreasers) |
| Industrial and commercial use in aerosol degreasers and cleaners |
| Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner1 |
| Consumer use as solvent in aerosol degreasers/cleaners |
| Consumer use in metal degreasers |
| Consumer use in automotive care products (degreasers) |
| Consumer use in carbon removers and other brush cleaners1 |
| Paint and Coating Removers (except aerospace and furniture refinishing) | Industrial and commercial use in paint and coating removers (except select wood furniture and safety critical, corrosion-sensitive components of aircraft and spacecraft) |
| Adhesive and Caulk Remover | Industrial and commercial use in adhesive and caulk removers |
| Consumer use in adhesive and caulk removers |
| Lithographic Printing Cleaner | Industrial and commercial use in lithographic printing plate cleaner |
| Dry Cleaning and Spot Removers | Industrial and commercial use in spot removers for apparel and textiles |
| Paint and Coatings | Industrial and commercial use in paints and coatings |
| Lubricants and Greases | Industrial and commercial use in liquid lubricants and greases |
| Industrial and commercial use in spray lubricants and greases |
| Consumer use in lubricants and greases |
| Cold Pipe Insulation | Industrial and commercial use in cold pipe insulations |
| Consumer use in cold pipe insulation |
| Anti-spatter Welding Aerosol | Industrial and commercial use as anti-spatter welding aerosol |
| Consumer use in an anti-spatter welding aerosol |
| Toys, Playground, and Supporting Equipment | Industrial and commercial use in toys, playground and sporting equipment |
| Uses believed to be inactive or fully overlap with other conditions of use | |  |  |
| Wood Floor and Brush Cleaners | Industrial and commercial use in carbon remover, wood floor cleaner, and brush cleaner1 | Prohibit | Prohibit |
| Consumer use in carbon removers and other brush cleaners1 |
| Consumer use in brush cleaners for paints and coatings2 |
| Functional Fluids | Industrial and commercial use in automotive care products (functional fluids for air conditioners2 |
| Consumer use in automotive care products (functional fluids for air conditioners)2 |
| Propellant and Blowing Agent | Industrial and commercial use as a propellant and blowing agent3 |
| Finishing Products for Fabric, Textiles and Leather | Industrial and commercial use in finishing products for fabric, textiles and leather4 |
| Industrial and commercial use in apparel and footwear care products4 |
| Electrical Equipment, Appliance, and Component Manufacturing | Industrial and commercial use for electrical equipment, appliance, and component manufacturing4 |
| Oil and Gas Drilling | Industrial and commercial use for oil and gas drilling, extraction, and support activities4 |
| 1EPA believes that brush cleaning is an inactive use. Wood floor cleaning is also believed to be an inactive use (although paint removers may be used for this purpose). Carbon removers are an active use and included under aerosol spray cleaning/degreasing. Note that these COUs are listed twice since they include both active and inactive uses.  2Based on market research, EPA believes these are inactive uses.  3Based on stakeholder outreach with industry, EPA believes this is an inactive use.  4These COUs are defined according to the sector using methylene chloride. EPA believes that there are no active uses in these sectors or that the uses by these sectors overlap with one or more of the COUs that are defined according to how the methylene chloride is being used.  Note: Use of methylene chloride by Federal agencies and contractors acting for or on behalf of Federal agencies are subject to a different compliance timeframe not captured in our analyses. | | | |

## Benefits From Avoided Mortality Risk Due to Acute Exposures

In several cases, acute exposures to methylene chloride in paint and coating removers have led to fatalities as a result of its depressive effects on the central nervous system ([EPA 2011b](#_ENREF_84), [EPA 2014b](#_ENREF_87)).

Mortality is thus a monetizable endpoint for methylene chloride. However, it is difficult to conduct dose-response modeling from the available case reports. EPA estimates fatalities due to acute methylene chloride exposures as follows. According to the Occupational Health and Safety Administration (OSHA), between 2000 and 2020, there were a total of 23 reported methylene chloride-related deaths associated with commercial bathtub refinishing ([Hoang, Fagan et al. 2021](#_ENREF_27); [OSHA 2022](#_ENREF_53)). Averaging the 23 reported deaths over the 20-year period of 2000-2021, there is approximately one death per year (1.05). Since all considered options prohibit the manufacture, processing, and distribution of methylene chloride-based paint and coating removers, EPA conservatively assumes that the regulatory action will result in one avoided fatality every year in this sector. Deaths from other uses (*i.e*., furniture refinishing, cleaning/degreasing, and adhesives) of methylene chloride totaled 7 over the same time, averaging to about a third of a death per year (0.35). Both regulatory actions mitigate unreasonable risk for all commercial uses of methylene chloride-based products, EPA assumes that each of the regulatory actions will result in one avoided fatality every three years among users of methylene chloride-based on the number of reported deaths in sectors outside of bathtub refinishing ([Hoang, Fagan et al. 2021](#_ENREF_27); [OSHA 2022](#_ENREF_53)).

Although the fact that deaths occur from exposure to methylene chloride is well documented, the exact number of deaths specifically attributable to methylene exposure is unclear. In 2012, the CDC Morbidity and Mortality Weekly Report (MMWR) published results of an investigation into deaths among bathtub refinishers using methylene chloride. The authors of the investigation and the MMWR editors emphasized that the reported number of deaths due to methylene chloride is an underestimate and subject to at least three limitations: A lack of reporting to the OSHA incident database by self-employed individuals; no equivalent database to track consumer incidents and fatalities; and the likelihood that deaths due to methylene chloride exposures are misattributed to heart disease, since the pathology is similar ([CDC 2012](#_ENREF_14)). The Bureau of Labor Statistics (BLS) publishes an annual Census of Fatal Occupational Injuries ([BLS 2019](#_ENREF_72)), across both employed and self-employed worker populations. EPA compared this data with that of the CDC, and was able to find a corresponding entry for each reported fatality in the CFOI data. The BLS data found an initial Methylene Chloride related fatality of a self-employed worker, working in the industry of “constructing, repairing, and cleaning.” Due to the likely underreporting of deaths from methylene chloride exposure while performing paint removal, the monetized benefits may be an underestimate of potential benefits of this rule. Another study found evidence of likely underreporting of fatalities due to methylene chloride or misreporting where death from methylene chloride is reported as other causes such as a heart attack. This study argues actual fatalities from methylene choride exposure may be as much as double the official reports, further indicating benefits from potential fatalities avoided is a lower bound ([Hoang, Fagan et al. 2021](#_ENREF_27)).

The value for mortality risk is estimated using EPA’s ([2014a](#_ENREF_86)) recommended value for a statistical life (VSL) of $4.8 million in 1990 dollars and EPA’s ([2014a](#_ENREF_86)) recommended method for adjusting the VSL for income growth and inflation. Specifically, the $4.8 million in 1990 dollars is adjusted for inflation using the CPI (U.S. BLS [2023a](#_ENREF_74)) and then adjusted for income growth using real GDP per capita ([U.S. Bureau of Economic Analysis 2023](#_ENREF_70)) and an income elasticity of 0.4.[[15]](#footnote-17) The annualized benefit estimates are $12.16 and $11.86 million for 3 and 7 percent discount rates, respectively.

## Number of Individuals with Exposure Reduction

Table 8‑2 presents the estimated numbers of individuals with exposure reductions. Descriptions of how these estimates were derived are presented in section 6.2.

| Table 8‑2: Number of Individuals with Methylene Chloride Exposure by Use Category | | | |
| --- | --- | --- | --- |
| Use Category | Occupational Users | Occupational Non-Users | Consumer Users |
| Manufacturing | 533 | 211 | - |
| Import/Repackage | 587 | 232 | - |
| Processing as a reactant | 703 | 277 | - |
| Incorporation Into Formulation, Mixture, or Reaction Product | 310 | 122 | - |
| Waste Handling, Disposal, Treatment, and Recycling | 7,493 | 4,746 | - |
| Laboratory Use | 183 | 0 | - |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | 352 | 0 | - |
| Aerospace Paint and Coating Removers | 762 | 72 | - |
| Cellulose Triacetate Film Production | 5 | 2 | - |
| Furniture Refinishing | 11,625 | 1,101 | - |
| Glues, Sealants, Adhesives, and Caulks | 40,862 | 12,259 | 13,917,131 |
| Vapor Degreasing | 71 | 42 | - |
| Liquid Cleaners and Degreasers | 14,900 | 35,760 | - |
| Aerosol Spray Cleaning/Degreasing | 523,102 | 58,122 | 184,310 |
| Paint and Coating Removers (Graffiti Removal) | 3,144 | 298 | - |
| Paint and Coating Removers (Bathtub Refinishing) | 725 | 69 | - |
| Paint and Coating Removers (Automotive Repair and Refinishing) | 12,619 | 1,195 | - |
| Paint and Coating Removers (Art Restoration) | 60 | 6 | - |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | 3,665 | 347 | - |
| Paint and Coating Removers (Professional Contracting) | 1,536 | 145 | - |
| Adhesive and Caulk Remover | 48,523 | 4,597 | 15,137 |
| Lithographic Printing Cleaner | 2,672 | 1,269 | - |
| Dry Cleaning and Spot Removers | 2,792 | 527 | - |
| Paint and Coatings | 799 | 151 | - |
| Lubricants and Greases | 46,967 | 5,448 | 1,086,470 |
| Cold Pipe Insulation | 46,521 | 5,396 | 138,855 |
| Anti-spatter Welding Aerosol | 14,820 | 1,719 | 5,411 |
| **Total** | **786,331** | **134,113** | **15,347,314** |

Table 8‑3 presents the estimated numbers of individuals with exposure reductions mapped to the categories for which exposures are estimated (not all workers and ONUs with estimated exposures in Table 8‑2 have estimated exposure reductions). This analysis only includes benefits estimates for workers and occupational non-users (ONUs); benefits for consumers who would avoid exposure under the analyzed options are not estimated. Note that ONU exposures are only available for select use categories, and benefits are only estimated for the ONUs where exposure estimates were available.

| Table 8‑3: Number of Individuals with Methylene Chloride Exposure, by Exposure Type | | | |
| --- | --- | --- | --- |
| Use Category | Occupational Exposure Scenario (OES) from Risk Evaluation | Exposure Type | Number of Individuals Exposed |
| Manufacturing | Manufacturing | Worker | 533 |
| Import/Repackage | Repackaging | Worker | 587 |
| Processing as a reactant | Processing as a Reactant | Worker | 703 |
| Incorporation Into Formulation, Mixture, or Reaction Product | Processing - Incorporation into Formulation, Mixture, or Reaction Product | Worker | 310 |
| Waste Handling, Disposal, Treatment, and Recycling | Waste Handling, Disposal, Treatment, and Recycling | Worker | 7,493 |
| Laboratory Use | Laboratory Use | Worker | 183 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Industrial and commercial use as a processing aid | Worker | 352 |
| Aerospace Paint and Coating Removers | Paint and coating removers/Aircraft Painting | Worker | 762 |
| Cellulose Triacetate Film Production | Cellulose triacetate film production | Worker | 5 |
| Furniture Refinishing | Paint and coating removers/Furniture Refinishing Industry | Worker | 11,625 |
| Glues, Sealants, Adhesives, and Caulks | Glues, sealants, adhesives, and caulks | Worker | 40,862 |
| Batch Vapor Degreasing1 | Batch Vapor Degreasing | Worker | 69 |
| Batch Vapor Degreasing1 | Batch Vapor Degreasing | ONU | 41 |
| Conveyorized Vapor Degreasing2 | Conveyorized Vapor Degreasing | Worker | 2 |
| Conveyorized Vapor Degreasing2 | Conveyorized Vapor Degreasing | ONU | 1 |
| Batch Cold Cleaning3 | Cold Cleaning | Worker | 745 |
| Liquid Cleaners and Degreasers (except batch)4 | Liquid cleaners and degreasers | Worker | 14,155 |
| Aerosol Spray Cleaning/Degreasing | Aerosol spray degreasing | Worker | 523,102 |
| Aerosol Spray Cleaning/Degreasing | Aerosol spray degreasing | ONU | 58,122 |
| Paint and Coating Removers (Graffiti Removal) | Paint and coating removers/graffiti Removal | Worker | 3,144 |
| Paint and Coating Removers (Bathtub Refinishing) | Paint and coating removers/Bathtub Refinishing | Worker | 725 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | Paint and coating removers/Automotive Repair and Refinishing | Worker | 12,619 |
| Paint and Coating Removers (Art Restoration) | Paint and coating removers/Art Restoration | Worker | 60 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | Paint and coating removers/Pleasure Craft Building and Repairing | Worker | 3,665 |
| Paint and Coating Removers (Professional Contracting) | Paint and coating removers/Professional Contracting | Worker | 1,536 |
| Adhesive and Caulk Remover | Adhesive and caulk remover | Worker | 48,523 |
| Lithographic Printing Cleaner | Lithographic printing cleaner | Worker | 2,672 |
| Dry Cleaning and Spot Removers | Dry cleaning and spot removers | Worker | 2,792 |
| Paint and Coatings | Paint and Coatings | Worker | 799 |
| Lubricants and Greases | Lubricants and greases | Worker | 46,967 |
| Cold Pipe Insulation | Cold pipe insulation | Worker | 46,521 |
| Anti-spatter Welding Aerosol | Anti-spatter welding aerosol | Worker | 14,820 |
| **Total** | - | - | **844,495** |
| 1Assumed to be 97% of vapor degreasing workers and ONUs.  2Assumed to be 3% of vapor degreasing workers and ONUs.  3Assumed to be 5% of liquid cleaners and degreasers workers and ONUs.  4Assumed to be 95% of liquid cleaners and degreasers workers and ONUs. | | | |

## Exposure Values from Risk Evaluation Used in the Benefits Analysis

The supplemental exposure files for the final risk evaluation ([EPA 2020d](#_ENREF_99)) included central (median) and high-end (95th percentile) changes in the Lifetime Average Daily Concentration (LADC) estimates for each of the use category/exposure type combinations listed above in Table 8‑3. These LADC estimates were divided by 31 years (central) or 40 years (high end) to get a change in LADC from eliminating one year of exposure. Then the mean change in the LADC was calculated by assuming exposures are distributed lognormally.[[16]](#footnote-18) These exposure estimates are adjusted by the percentages shown in Table 8‑4 to account for baseline PPE use. The estimated percentage of baseline PPE use by APF shown in Table 8‑4 is described in Appendix C ([Abt Associates 2023a](#_ENREF_3)). The adjustment to exposure to account for baseline PPE use is calculated based on the APF and the percentage of baseline use of each APF. For example, the 73% adjustment for manufacturing is calculated as follows:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table 8‑4: Adjustment to Exposure to Account for Baseline PPE Use | | | | | | | |
| Sector | Percent Baseline PPE use, by APF | | | | | | Adjustment to Exposure to Account for Baseline PPE Use |
| No PPE | APF 10 | APF 25 | APF 50 | APF 1,000 | APF 10,000 |
| Manufacturing | 72% | 11% | 0% | 7% | 8% | 2% | 73% |
| Construction | 78% | 8% | 1% | 6% | 5% | 1% | 79% |
| Transportation and Public Utilities | 88% | 4% | 0% | 3% | 4% | 2% | 89% |
| Services | 95% | 3% | 0% | 1% | 1% | 0% | 95% |
| Note: Baseline PPE use for the construction sector is used for graffiti, bathtub refinishing, and professional contracting paint and coating removers and cold pipe insulation end users. Baseline PPE use for the mining sector estimates are used for oil and gas drilling. Baseline PPE use for the transportation and public utilities sector estimates are used for waste handling, disposal, and recycling. Baseline PPE use for the services sector estimates are used for furniture refinishing, automotive repair and refinishing, and art restoration paint and coating removers, dry cleaning and spot removers, aerosol cleaner/degreasers, and lubricant and grease end users. Baseline PPE use for the manufacturing sector is used for all other use categories. | | | | | | | |

Table 8‑5 presents the mean increase in the LADC from one year of baseline occupational exposure, with and without the baseline PPE adjustment and describes how this was calculated from the 50th and 95th percentile LADCs calculated for the risk evaluation.

| Table 8‑5: Mean Increase in LADC from One Year of Baseline Occupational Exposure, by Use Category and Exposure Type | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Use Category | Exposure Type | Change in LADC Estimated for Risk Evaluation1 (ppm) | | Change in LADC from One Year of Occupational Exposure (ppm) | | Mean Change in LADC from One Year of Occupational Exposure (ppm) | |
| 50th Percentile | 95th Percentile | 50th Percentile | 95th Percentile | Without Accounting for Baseline PPE Use2 | After Accounting for Baseline PPE Use3 |
|  |  | A | B | C = A/31 | D = B/40 | E | F |
| Manufacturing | Worker | 144.96 | 2,360.28 | 4.68 | 59.01 | 15.34 | 11.19 |
| Import/Repackage | Worker | 3,506.57 | 70,612.45 | 113.12 | 1,765.31 | 456.52 | 333.18 |
| Processing as a reactant | Worker | 648.85 | 55,302.90 | 20.93 | 1,382.57 | 537.23 | 392.08 |
| Incorporation Into Formulation, Mixture, or Reaction Product | Worker | 40,420.23 | 275,757.43 | 1,303.88 | 6,893.94 | 2,176.79 | 1,588.67 |
| Waste Handling, Disposal, Treatment, and Recycling | Worker | 931.66 | 41,373.20 | 30.05 | 1,034.33 | 303.98 | 269.36 |
| Laboratory Use | Worker | 2,400.13 | 52,274.26 | 77.42 | 1,306.86 | 338.76 | 247.23 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Worker | 411,861.44 | 555,747.00 | 13,285.85 | 13,893.67 | 13,290.77 | 9,699.89 |
| Aerospace Paint and Coating Removers | Worker | 253,620.35 | 496,020.87 | 8,181.30 | 12,400.52 | 8,447.04 | 6,164.83 |
| Cellulose Triacetate Film Production | Worker | 411,861.44 | 555,747.00 | 13,285.85 | 13,893.67 | 13,290.77 | 9,699.89 |
| Furniture Refinishing | Worker | 32,099.49 | 292,889.76 | 1,035.47 | 7,322.24 | 2,100.04 | 1,996.65 |
| Glues, Sealants, Adhesives, and Caulks | Worker | 10,809.82 | 353,331.71 | 348.70 | 8,833.29 | 2,403.65 | 1,754.23 |
| Batch Vapor Degreasing | Worker | 66,888.46 | 381,948.72 | 2,157.69 | 9,548.72 | 3,247.48 | 2,370.08 |
| Batch Vapor Degreasing | ONU | 34,366.28 | 233,656.41 | 1,108.59 | 5,841.41 | 1,846.88 | 1,347.89 |
| Conveyorized Vapor Degreasing | Worker | 193,312.82 | 715,384.62 | 6,235.90 | 17,884.62 | 7,655.91 | 5,587.45 |
| Conveyorized Vapor Degreasing | ONU | 100,547.25 | 461,521.28 | 3,243.46 | 11,538.03 | 4,367.75 | 3,187.68 |
| Batch Cold Cleaning | Worker | 111,282.05 | 512,820.51 | 3,589.74 | 12,820.51 | 4,843.06 | 3,534.57 |
| Liquid Cleaners and Degreasers (except batch) | Worker | 22,517.33 | 476,966.67 | 726.37 | 11,924.17 | 3,087.57 | 2,253.38 |
| Aerosol Spray Cleaning/Degreasing | Worker | 8,743.59 | 40,358.97 | 282.05 | 1,008.97 | 380.82 | 362.07 |
| Aerosol Spray Cleaning/Degreasing | ONU | 158.97 | 1,671.79 | 5.13 | 41.79 | 11.57 | 11.00 |
| Paint and Coating Removers (Graffiti Removal) | Worker | 16,026.28 | 154,990.22 | 516.98 | 3,874.76 | 1,094.21 | 866.35 |
| Paint and Coating Removers (Bathtub Refinishing) | Worker | 198,303.98 | 388,780.17 | 6,396.90 | 9,719.50 | 6,607.16 | 5,231.26 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | Worker | 32,614.85 | 54,272.67 | 1,052.09 | 1,356.82 | 1,064.75 | 843.02 |
| Paint and Coating Removers (Art Restoration) | Worker | 217.00 | 760.04 | 7.00 | 19.00 | 8.42 | 8.00 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | Worker | 32,614.85 | 54,272.67 | 1,052.09 | 1,356.82 | 1,064.75 | 777.08 |
| Paint and Coating Removers (Professional Contracting) | Worker | 198,303.98 | 388,780.17 | 6,396.90 | 9,719.50 | 6,607.16 | 5,231.26 |
| Adhesive and Caulk Remover | Worker | 604,102.56 | 1,528,205.13 | 19,487.18 | 38,205.13 | 21,189.67 | 15,464.67 |
| Lithographic Printing Cleaner | Worker | 3,461.95 | 82,186.57 | 111.68 | 2,054.66 | 535.39 | 390.74 |
| Dry Cleaning and Spot Removers | Worker | 264.45 | 95,128.12 | 8.53 | 2,378.20 | 2,987.89 | 2,840.80 |
| Paint and Coatings | Worker | 27,741.03 | 186,926.97 | 894.87 | 4,673.17 | 1,482.66 | 1,082.08 |
| Lubricants and Greases | Worker | 22,517.33 | 476,966.67 | 726.37 | 11,924.17 | 3,087.57 | 2,935.57 |
| Cold Pipe Insulation | Worker | 22,517.33 | 476,966.67 | 726.37 | 11,924.17 | 3,087.57 | 2,444.61 |
| Anti-spatter Welding Aerosol | Worker | 22,517.33 | 476,966.67 | 726.37 | 11,924.17 | 3,087.57 | 2,253.38 |
| 1See https://www.epa.gov/sites/default/files/2020-06/18\_mecl\_supplemental\_file\_risk\_calculator\_for\_occupational\_exposure\_0.xlsx  2Estimated from columns C and D, assuming exposure is lognormally distributed (i.e., calculated in excel using the following formula: =EXP(LN(C)+(((LN(C)-LN(D))/(NORMSINV(0.5)-NORMSINV(0.95)))^2)/2)).  3See Table 8‑4. | | | | | | | |

Table 8‑6 presents the estimated exposure under a workplace chemical protection program (WCPP) as a percentage of the baseline exposure for each monitoring threshold. The estimates in Table 8‑6 are calculated assuming that PPE with the minimum compliant and available APF is worn by workers and ONUs not wearing baseline compliant PPE. Since supplied air respirators (SAR) with an APF of 10 are assumed to be unavailable[[17]](#footnote-19), it is assumed that APF 25 respirators are used when APF 10 respirators are needed. The following examples illustrate how the values in Table 8‑6 are calculated from the estimates in Table 8‑4:

* The 4.8% in the manufacturing sector row and the “< 10 times the ECEL” column is calculated as [(72%+11%+0%)/25 + 7%/50 + 8%/1,000 + 2%/10,000]/73%. Thus, the percentage of workers or ONUs using no PPE or PPE with an APF of 10 in the baseline would switch to PPE with an APF of 25.
* The 0.1% in the Transportation and Public Utilities sector row and the “<1,000 times the ECEL” column is calculated as [(88%+4%+0%+3%+4%)/1,000 + 2%/10,000]/89%. Thus, the percentage of workers or ONUs using no PPE or PPE with an APF of less than 50 in the baseline would switch to PPE with an APF of 1,000.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 8‑6: Exposure Under the WCPP as a Percentage of Baseline Exposure, by Monitoring Threshold | | | | | |
| Sector | Between ECEL and < 10 times the ECEL | 10 to < 25 times the ECEL | 25 to < 50 times the ECEL | 50 to < 1,000 times the ECEL | 1,000 to < 10,000 times the ECEL |
| Manufacturing | 4.8% | 4.8% | 2.5% | 0.1% | 0.01% |
| Transportation and Public Utilities | 4.2% | 4.2% | 2.1% | 0.1% | 0.01% |
| Construction | 4.6% | 4.6% | 2.4% | 0.1% | 0.01% |
| Services | 4.1% | 4.1% | 2.1% | 0.1% | 0.01% |
| Note: Estimates for the transportation and public utilities sector estimates are used for waste handling, disposal, and recycling. Estimates for the manufacturing sector are used for all other use categories where for which a WCPP is applicable under one of the options. | | | | | |

The supplemental exposure files for the final risk evaluation ([EPA 2020d](#_ENREF_99)) included central (median) and high-end (95th percentile) 8-hour time weighted average exposure estimates for each of the use category/exposure type combinations listed above in Table 8‑3. The estimated percentages of workers and ONUs in each ECEL threshold category was estimated from these median and 95th percentile values by assuming a lognormal distribution for exposure (see the estimated percentages of workers and ONUs in each ECEL threshold category presented in Table 8‑7).

Table 8‑8 presents the mean increase in the LADC for the use categories affected by WCPP requirements under the options, disaggregated by the ECEL threshold levels, from one year of *baseline* occupational exposure. Table 8‑9 presents the mean increase in the LADC from one year of exposure *with compliance with the WCPP* (relative to zero exposure). Table 8‑10 presents the incremental reductions in the mean LADCs under the WCPP (*i.e.*, the difference between the LADCs presented in Table 8‑8 and Table 8‑9.

| Table 8‑7: Estimated Percentage of Workers and ONUs by ECEL Threshold Category | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Use Category | Exposure Type | <Action Level | Between Action Level and Limit | Between ECEL and < 10 times the ECEL | 10 to < 25 times the ECEL | 25 to < 50 times the ECEL | 50 to < 1,000 times the ECEL | 1,000 to < 10,000 times the ECEL |
| Manufacturing | Worker | 92% | 5% | 3% | - | - | - | - |
| Import/Repackage | Worker | 28% | 16% | 45% | 7% | 2% | 2% | - |
| Processing as a reactant | Worker | 61% | 10% | 21% | 4% | 2% | 2% | - |
| Incorporation Into Formulation, Mixture, or Reaction Product | Worker | - | - | 35% | 35% | 18% | 12% | - |
| Waste Handling, Disposal, Treatment, and Recycling | Worker | 57% | 12% | 25% | 3% | 1% | 2% | - |
| Laboratory Use | Worker | 37% | 16% | 39% | 5% | 2% | 1% | - |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Worker | - | - | - | - | - | 100% | - |
| Aerospace Paint and Coating Removers | Worker | - | - | - | - | - | 100% | - |
| Cellulose Triacetate Film Production | Worker | - | - | - | - | - | 100% | - |
| Furniture Refinishing | Worker | - | 1% | 43% | 30% | 15% | 11% | - |
| Glues, Sealants, Adhesives, and Caulks | Worker | 14% | 10% | 44% | 14% | 8% | 10% | - |
| Batch Vapor Degreasing | Worker | - | - | 16% | 35% | 27% | 22% | - |
| Batch Vapor Degreasing | ONU | - | - | 41% | 34% | 16% | 9% | - |
| Conveyorized Vapor Degreasing | Worker | - | - | - | 5% | 24% | 71% | - |
| Conveyorized Vapor Degreasing | ONU | - | - | 4% | 27% | 34% | 35% | - |
| Batch Cold Cleaning | Worker | - | - | 3% | 23% | 34% | 40% | - |
| Liquid Cleaners and Degreasers (except batch)Graffiti | Worker | 5% | 5% | 44% | 20% | 11% | 15% | - |
| Aerosol Spray Cleaning/Degreasing | Worker | - | 6% | 87% | 7% | - | - | - |
| Aerosol Spray Cleaning/Degreasing | ONU | 95% | 3% | 2% | - | - | - | - |
| Paint and Coating Removers (Graffiti Removal) | Worker | 2% | 5% | 60% | 21% | 8% | 4% | - |
| Paint and Coating Removers (Bathtub Refinishing) | Worker | - | - | - | - | 7% | 93% | - |
| Paint and Coating Removers (Automotive Repair and Refinishing) | Worker | - | - | 14% | 86% | - | - | - |
| Paint and Coating Removers (Art Restoration) | Worker | 100% | - | - | - | - | - | - |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | Worker | - | - | 14% | 86% | - | - | - |
| Paint and Coating Removers (Professional Contracting) | Worker | - | - | - | - | 7% | 93% | - |
| Adhesive and Caulk Remover | Worker | - | - | - | - | - | 100% | - |
| Lithographic Printing Cleaner | Worker | 30% | 14% | 43% | 8% | 3% | 2% | - |
| Dry Cleaning and Spot Removers | Worker | 68% | 7% | 16% | 3% | 2% | 3% | 1% |
| Paint and Coatings | Worker | - | 1% | 48% | 32% | 13% | 6% | - |
| Lubricants and Greases | Worker | 5% | 5% | 44% | 20% | 11% | 15% | - |
| Cold Pipe Insulation | Worker | 5% | 5% | 44% | 20% | 11% | 15% | - |
| Anti-spatter Welding Aerosol | Worker | 5% | 5% | 44% | 20% | 11% | 15% | - |

| Table 8‑8: Estimated Baseline Increase in LADC from One Year of Occupational Exposure, by Facility ECEL Threshold Category (adjusted for baseline PPE Use) | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Use Category | Exposure Type | Median and 95% LADC Across all Facilities | | <Action Level | Between Action Level and Limit | Between ECEL and < 10 times the ECEL | 10 to < 25 times the ECEL | 25 to < 50 times the ECEL | 50 to < 1,000 times the ECEL | 1,000 to < 10,000 times the ECEL | Average Across All Thresholds1 |
| Median | 95th Percentile |
| Manufacturing | Worker | 3.4 | 43.1 | 5.6 | 45.3 | 126.3 | - | - | - | - | 11.2 |
| Import/Repackage | Worker | 82.6 | 1,288.4 | 15.0 | 47.2 | 224.4 | 1,035.2 | 2,230.8 | 5,169.6 | - | 333.2 |
| Processing as a reactant | Worker | 15.3 | 1,009.0 | 7.7 | 46.3 | 205.2 | 947.1 | 2,350.1 | 12,737.0 | - | 392.1 |
| Incorporation Into Formulation, Mixture, or Reaction Product | Worker | 951.6 | 5,031.3 | - | - | 376.6 | 1,065.5 | 2,264.8 | 5,635.3 | - | 1,588.7 |
| Waste Handling, Disposal, Treatment, and Recycling | Worker | 26.6 | 916.5 | 11.8 | 57.2 | 258.0 | 1,196.6 | 2,208.9 | 6,664.8 | - | 269.4 |
| Laboratory Use | Worker | 56.5 | 953.8 | 13.9 | 47.4 | 214.7 | 1,011.7 | 2,500.7 | 5,018.2 | - | 247.2 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Worker | 9,696.3 | 10,139.9 | - | - | - | - | - | 9,699.9 | - | 9,699.9 |
| Aerospace Paint and Coating Removers | Worker | 5,970.9 | 9,050.2 | - | - | - | - | - | 6,164.8 | - | 6,164.8 |
| Cellulose Triacetate Film Production | Worker | 9,696.3 | 10,139.9 | - | - | - | - | - | 9,699.9 | - | 9,699.9 |
| Furniture Refinishing | Worker | 984.5 | 6,961.8 | - | 61.9 | 426.2 | 1,369.4 | 3,030.7 | 8,612.4 | - | 1,996.7 |
| Glues, Sealants, Adhesives, and Caulks | Worker | 254.5 | 6,446.7 | 15.6 | 47.6 | 259.3 | 1,032.4 | 2,301.4 | 13,045.5 | - | 1,754.2 |
| Batch Vapor Degreasing | Worker | 1,574.7 | 6,968.9 | - | - | 443.3 | 1,103.1 | 2,292.1 | 5,882.7 | - | 2,370.1 |
| Batch Vapor Degreasing | ONU | 809.1 | 4,263.2 | - | - | 362.0 | 1,047.3 | 2,247.2 | 5,375.9 | - | 1,347.9 |
| Conveyorized Vapor Degreasing | Worker | 4,551.1 | 13,052.6 | - | - | - | 1,336.1 | 2,480.3 | 6,937.1 | - | 5,587.4 |
| Conveyorized Vapor Degreasing | ONU | 2,367.1 | 8,420.7 | - | - | 511.7 | 1,159.9 | 2,340.5 | 5,880.7 | - | 3,187.7 |
| Batch Cold Cleaning | Worker | 2,619.9 | 9,356.7 | - | - | 526.2 | 1,162.0 | 2,343.2 | 6,137.1 | - | 3,534.6 |
| Liquid Cleaners and Degreasers (except batch)Graffiti | Worker | 530.1 | 8,702.5 | 21.4 | 48.7 | 279.4 | 1,042.0 | 2,282.7 | 11,116.3 | - | 2,253.4 |
| Aerosol Spray Cleaning/Degreasing | Worker | 268.2 | 959.3 | - | 64.3 | 315.9 | 1,191.4 | - | - | - | 362.1 |
| Aerosol Spray Cleaning/Degreasing | ONU | 4.9 | 39.7 | 7.7 | 55.4 | 102.6 | - | - | - | - | 11.0 |
| Paint and Coating Removers (Graffiti Removal) | Worker | 409.3 | 3,067.9 | 28.4 | 54.3 | 312.7 | 1,113.4 | 2,500.9 | 6,039.3 | - | 866.3 |
| Paint and Coating Removers (Bathtub Refinishing) | Worker | 5,064.8 | 7,695.5 | - | - | - | - | 3,202.2 | 5,384.0 | - | 5,231.3 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | Worker | 833.0 | 1,074.3 | - | - | 659.2 | 872.9 | - | - | - | 843.0 |
| Paint and Coating Removers (Art Restoration) | Worker | 6.7 | 18.1 | 8.0 | - | - | - | - | - | - | 8.0 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | Worker | 767.8 | 990.2 | - | - | 607.6 | 804.7 | - | - | - | 777.1 |
| Paint and Coating Removers (Professional Contracting) | Worker | 5,064.8 | 7,695.5 | - | - | - | - | 3,202.2 | 5,384.0 | - | 5,231.3 |
| Adhesive and Caulk Remover | Worker | 14,222.2 | 27,882.9 | - | - | - | - | - | 15,464.7 | - | 15,464.7 |
| Lithographic Printing Cleaner | Worker | 81.5 | 1,499.5 | 14.7 | 47.0 | 217.5 | 987.7 | 2,392.9 | 6,770.7 | - | 390.7 |
| Dry Cleaning and Spot Removers | Worker | 8.1 | 2,261.1 | 6.8 | 61.1 | 301.4 | 1,308.0 | 2,754.7 | 12,513.9 | 231,391.5 | 2,840.8 |
| Paint and Coatings | Worker | 653.1 | 3,410.6 | - | 63.1 | 346.5 | 1,022.4 | 2,219.0 | 4,991.3 | - | 1,082.1 |
| Lubricants and Greases | Worker | 690.6 | 11,337.1 | 27.9 | 63.4 | 364.0 | 1,357.5 | 2,973.8 | 14,481.7 | - | 2,935.6 |
| Cold Pipe Insulation | Worker | 575.1 | 9,441.0 | 23.2 | 52.8 | 303.1 | 1,130.4 | 2,476.5 | 12,059.6 | - | 2,444.6 |
| Anti-spatter Welding Aerosol | Worker | 530.1 | 8,702.5 | 21.4 | 48.7 | 279.4 | 1,042.0 | 2,282.7 | 11,116.3 | - | 2,253.4 |
| 1This average value is the weighted average across the 7 thresholds (weighted using the percentages presented in Table 8‑7) and is the same as the value shown in Table 8‑5. | | | | | | | | | | | |

| Table 8‑9: Estimated Post-Compliance Increase in LADC from One Year of Occupational Exposure Under a WCPP, by Facility ECEL Threshold Category | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Use Category | Exposure Type | <Action Level1 | Between Action Level and Limit1 | Between ECEL and < 10 times the ECEL2 | 10 to < 25 times the ECEL2 | 25 to < 50 times the ECEL2 | 50 to < 1,000 times the ECEL2 | 1,000 to < 10,000 times the ECEL2 | Average Across All Thresholds3 |
| Manufacturing | Worker | 5.6 | 45.3 | 6.0 | - | - | - | - | 7.6 |
| Import/Repackage | Worker | 15.0 | 47.2 | 10.7 | 49.2 | 55.5 | 7.0 | - | 21.2 |
| Processing as a reactant | Worker | 7.7 | 46.3 | 9.8 | 45.0 | 58.4 | 17.2 | - | 14.7 |
| Incorporation Into Formulation, Mixture, or Reaction Product | Worker | - | - | 17.9 | 50.7 | 56.3 | 7.6 | - | 35.0 |
| Waste Handling, Disposal, Treatment, and Recycling | Worker | 11.8 | 57.2 | 12.3 | 56.9 | 54.9 | 9.0 | - | 19.1 |
| Laboratory Use | Worker | 13.9 | 47.4 | 10.2 | 48.1 | 62.2 | 6.8 | - | 20.4 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Worker | - | - | - | - | - | 13.1 | - | 13.1 |
| Aerospace Paint and Coating Removers | Worker | - | - | - | - | - | 8.3 | - | 8.3 |
| Cellulose Triacetate Film Production | Worker | - | - | - | - | - | 13.1 | - | 13.1 |
| Furniture Refinishing | Worker | - | 61.9 | 17.6 | 56.6 | 63.0 | 9.0 | - | 35.6 |
| Glues, Sealants, Adhesives, and Caulks | Worker | 15.6 | 47.6 | 12.3 | 49.1 | 57.2 | 17.6 | - | 25.6 |
| Batch Vapor Degreasing | Worker | - | - | 18.7 | 46.4 | 48.9 | 6.5 | - | 33.9 |
| Batch Vapor Degreasing | ONU | - | - | 15.2 | 44.1 | 48.0 | 6.0 | - | 29.4 |
| Conveyorized Vapor Degreasing | Worker | - | - | - | 56.2 | 53.0 | 7.7 | - | 21.0 |
| Conveyorized Vapor Degreasing | ONU | - | - | 21.5 | 48.8 | 50.0 | 6.5 | - | 33.3 |
| Batch Cold Cleaning | Worker | - | - | 24.1 | 53.1 | 55.5 | 7.7 | - | 34.9 |
| Liquid Cleaners and Degreasers (except batch)Graffiti | Worker | 21.4 | 48.7 | 12.8 | 47.6 | 54.1 | 13.9 | - | 26.7 |
| Aerosol Spray Cleaning/Degreasing | Worker | - | 64.3 | 14.4 | 54.5 | - | - | - | 20.2 |
| Aerosol Spray Cleaning/Degreasing | ONU | 7.7 | 55.4 | 4.7 | - | - | - | - | 9.0 |
| Paint and Coating Removers (Graffiti Removal) | Worker | 28.4 | 54.3 | 14.3 | 50.9 | 59.2 | 7.5 | - | 27.6 |
| Paint and Coating Removers (Bathtub Refinishing) | Worker | - | - | - | - | 75.9 | 6.7 | - | 11.6 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | Worker | - | - | 27.2 | 36.1 | - | - | - | 34.8 |
| Paint and Coating Removers (Art Restoration) | Worker | 8.0 | - | - | - | - | - | - | 8.0 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | Worker | - | - | 28.9 | 38.3 | - | - | - | 37.0 |
| Paint and Coating Removers (Professional Contracting) | Worker | - | - | - | - | 75.9 | 6.7 | - | 11.6 |
| Adhesive and Caulk Remover | Worker | - | - | - | - | - | 20.8 | - | 20.8 |
| Lithographic Printing Cleaner | Worker | 14.7 | 47.0 | 10.3 | 47.0 | 59.5 | 9.1 | - | 21.2 |
| Dry Cleaning and Spot Removers | Worker | 6.8 | 61.1 | 14.3 | 62.2 | 68.5 | 16.9 | 31.7 | 15.3 |
| Paint and Coatings | Worker | - | 63.1 | 16.5 | 48.6 | 55.2 | 6.7 | - | 31.7 |
| Lubricants and Greases | Worker | 27.9 | 63.4 | 17.3 | 64.6 | 73.9 | 19.5 | - | 36.2 |
| Cold Pipe Insulation | Worker | 23.2 | 52.8 | 14.4 | 53.8 | 61.6 | 16.2 | - | 30.1 |
| Anti-spatter Welding Aerosol | Worker | 21.4 | 48.7 | 13.3 | 49.6 | 56.7 | 15.0 | - | 27.7 |
| 1These values are the same as those shown in Table 8‑8, since steps to reduce exposure are not required when monitoring results indicate that exposure is below the ECEL.  2These values are calculated by multiplying the baseline exposure estimates in Table 8‑8 by the corresponding percentage shown in Table 8‑6.  3This average value is the weighted average across the 7 thresholds. | | | | | | | | | |

| Table 8‑10: Estimated Incremental Reduction in LADC from One Year of Occupational Exposure Under a WCPP, by Facility ECEL Threshold Category1 | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Use Category | Exposure Type | <Action Level | Between Action Level and Limit | Between ECEL and < 10 times the ECEL | 10 to < 25 times the ECEL | 25 to < 50 times the ECEL | 50 to < 1,000 times the ECEL | 1,000 to < 10,000 times the ECEL | Average Across All Thresholds |
| Manufacturing | Worker | - | - | 120.3 | - | - | - | - | 3.6 |
| Import/Repackage | Worker | - | - | 213.7 | 985.9 | 2,175.3 | 5,162.6 | - | 311.9 |
| Processing as a reactant | Worker | - | - | 195.5 | 902.0 | 2,291.7 | 12,719.8 | - | 377.4 |
| Incorporation Into Formulation, Mixture, or Reaction Product | Worker | - | - | 358.7 | 1,014.9 | 2,208.5 | 5,627.7 | - | 1,553.6 |
| Waste Handling, Disposal, Treatment, and Recycling | Worker | - | - | 245.8 | 1,139.7 | 2,153.9 | 6,655.8 | - | 250.3 |
| Laboratory Use | Worker | - | - | 204.5 | 963.6 | 2,438.5 | 5,011.4 | - | 226.8 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Worker | - | - | - | - | - | 9,686.8 | - | 9,686.8 |
| Aerospace Paint and Coating Removers | Worker | - | - | - | - | - | 6,156.5 | - | 6,156.5 |
| Cellulose Triacetate Film Production | Worker | - | - | - | - | - | 9,686.8 | - | 9,686.8 |
| Furniture Refinishing | Worker | - | - | 408.6 | 1,312.8 | 2,967.7 | 8,603.4 | - | 1,961.0 |
| Glues, Sealants, Adhesives, and Caulks | Worker | - | - | 247.0 | 983.3 | 2,244.2 | 13,028.0 | - | 1,728.7 |
| Batch Vapor Degreasing | Worker | - | - | 424.6 | 1,056.7 | 2,243.2 | 5,876.2 | - | 2,336.2 |
| Batch Vapor Degreasing | ONU | - | - | 346.8 | 1,003.2 | 2,199.2 | 5,369.9 | - | 1,318.4 |
| Conveyorized Vapor Degreasing | Worker | - | - | - | 1,279.9 | 2,427.3 | 6,929.5 | - | 5,566.5 |
| Conveyorized Vapor Degreasing | ONU | - | - | 490.1 | 1,111.1 | 2,290.5 | 5,874.2 | - | 3,154.4 |
| Batch Cold Cleaning | Worker | - | - | 502.1 | 1,108.9 | 2,287.6 | 6,129.4 | - | 3,499.7 |
| Liquid Cleaners and Degreasers (except batch)Graffiti | Worker | - | - | 266.6 | 994.4 | 2,228.7 | 11,102.4 | - | 2,226.7 |
| Aerosol Spray Cleaning/Degreasing | Worker | - | - | 301.4 | 1,136.9 | - | - | - | 341.8 |
| Aerosol Spray Cleaning/Degreasing | ONU | - | - | 97.9 | - | - | - | - | 2.0 |
| Paint and Coating Removers (Graffiti Removal) | Worker | - | - | 298.4 | 1,062.5 | 2,441.7 | 6,031.7 | - | 838.8 |
| Paint and Coating Removers (Bathtub Refinishing) | Worker | - | - | - | - | 3,126.3 | 5,377.3 | - | 5,219.7 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | Worker | - | - | 632.0 | 836.9 | - | - | - | 808.2 |
| Paint and Coating Removers (Art Restoration) | Worker | - | - | - | - | - | - | - | 0.0 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | Worker | - | - | 578.7 | 766.4 | - | - | - | 740.1 |
| Paint and Coating Removers (Professional Contracting) | Worker | - | - | - | - | 3,126.3 | 5,377.3 | - | 5,219.7 |
| Adhesive and Caulk Remover | Worker | - | - | - | - | - | 15,443.8 | - | 15,443.8 |
| Lithographic Printing Cleaner | Worker | - | - | 207.2 | 940.7 | 2,333.4 | 6,761.6 | - | 369.6 |
| Dry Cleaning and Spot Removers | Worker | - | - | 287.0 | 1,245.8 | 2,686.2 | 12,497.1 | 231,359.8 | 2,825.5 |
| Paint and Coatings | Worker | - | - | 330.1 | 973.7 | 2,163.8 | 4,984.6 | - | 1,050.4 |
| Lubricants and Greases | Worker | - | - | 346.7 | 1,292.9 | 2,899.9 | 14,462.1 | - | 2,899.4 |
| Cold Pipe Insulation | Worker | - | - | 288.7 | 1,076.7 | 2,414.9 | 12,043.4 | - | 2,414.5 |
| Anti-spatter Welding Aerosol | Worker | - | - | 266.1 | 992.4 | 2,226.0 | 11,101.3 | - | 2,225.6 |
| 1The estimates presented in this table are calculated as the difference between the values in Table 8‑8 and Table 8‑9. | | | | | | | | | |

## Excess Cancer Risk Estimates

The steps taken to arrive at the unit risk values are outlined in Appendix I of the final risk evaluation ([EPA 2020i](#_ENREF_104); specifically in Section I.1 starting on page 682). To arrive at the excess cancer risk estimates used in the benefits analysis, EPA carried forward the benchmark dose (BMD) instead of the benchmark dose limit (BMDL) through all of the steps presented in Section I.1, including the application of an allometric scaling factor, the linear extrapolation approach to calculating human tumor risk factors, and finally the calculation of the excess cancer risk. The BMD is used instead of the BMDL in order to obtain central estimates for the excess cancer risks from exposure to methylene chloride (using the BMDL, as is done for estimating an inhalation unit risk, would result in an upper bound estimate for excess cancer risk). Table 3-20 of the risk evaluation specifies that the human inhalation unit risk (IUR) is calculated by multiplying the mean human internal dose from 1 µg/m3 exposure and the tumor risk factor together.[[18]](#footnote-20) Although the value for the mean human internal dose from 1 µg/m3 was derived from a distribution of internal doses estimated using a probabilistic human physiological based pharmacokinetic (PBPK) model, this model did not need to be re-estimated, because the mean values are already published in Table 3-20. Using the BMD instead of the BMDL for the calculation of the excess cancer risk does not change the distribution of internal doses from 1 µg/m3 estimated by the PBPK model. Thus, to perform the calculation of the excess cancer risk using the BMD for liver or lung tumors in male mice from NTP (1986), EPA used the following steps:

**Step 1:** Apply the allometric scaling factor to the BMD:

* BMDhuman = BMDmouse / allometric scaling factor
  + Where:
    - BMDmouse = 9.764454 (mg metabolized via GST in lung and liver/kg-day)
    - Allometric scaling factor = 7 (see page 683 of the risk evaluation)
  + Therefore:
    - BMDhuman = 9.764454 / 7
    - **BMDhuman = 1.395 (mg metabolized/kg-d)**

**Step 2:** Apply the linear extrapolation approach to calculate human tumor risk factors by dividing the benchmark response (BMR) of 0.1 by the human BMD:

* Human tumor risk factor = BMR / BMDhuman
* Where:
  + BMR = 0.1
  + BMDhuman = 1.395
* Therefore:
  + Human tumor risk factor = 0.1 / 1.395
  + **Human tumor risk factor = 7.17 x 10-2 (extra risk per mg metabolized/kg-d)**

**Step 3:** Multiply the human tumor risk factor by the mean human internal dose from 1 µg/m3 exposure in the mixed population to get the human inhalation excess cancer risk for the general population:

* + Excess cancer risk = human tumor risk factor x mean internal dose
  + Where:
    - Human tumor risk factor = 7.17 x 10-2
    - Mean internal dose from 1 µg/m3 = 1.53 x 10-8 (mg metabolized/kg-d, see page 310 of the risk evaluation)
  + Therefore:
    - Excess cancer risk = 0.0717 x 1.53 x 10-8
    - **Excess cancer risk = 1.10 x 10-9 (µg/m3)-1**

These calculations are shown below in Table 8‑11 and presented separately for liver and lung cancer.

| Table 8‑11: Excess Cancer Risk Calculation | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Cancer Site | BMD1 | Allometric scaling factor2 | BMDhuman | Human tumor risk factor | Mean Internal Dose3 | Excess Cancer Risk  (per 1 µg/m3) |
| (A) | (B) | (C) = (A)/(B) | (D) = 0.1 / (C) | (E) | (F) = (D) \* (E) |
| Liver or Lung | 9.76445 | 7 | 1.39492 | 0.071688596 | 1.53E-08 | 1.10E-09 |
| Liver | 38.73476 | 7 | 5.53354 | 0.018071624 | 1.53E-08 | 2.76E-10 |
| Lung | 13.05575 | 7 | 1.86511 | 0.053616223 | 1.53E-08 | 8.20E-10 |
| 1See page 126 of the supplemental file related to benchmark dose and PBPK modeling.  2See page 683 of the risk evaluation.  3See page 310 of the risk evaluation. | | | | | | |

## Microrisk Reductions for Lung and Liver Cancer Per Individual Attributable to Reducing Methylene Chloride Exposure Under the Options

This section presents the estimated reductions in cancer risk per individual attributable to reducing methylene chloride exposure under the options. The estimated risk reductions are presented in terms of microrisk reductions, where a microrisk is equivalent to reducing the risk for a case of cancer by one in one million. The microrisk reductions are calculated by combining the changes in the LADCs presented above in Table 8‑5 and Table 8‑10 with the excess cancer risk estimates presented in Table 8‑11.

Table 8‑13 and Table 8‑14 present the estimates for the microrisk reductions per exposed individual under a scenario for eliminating one year of exposure (Table 8‑13) and under a scenario for reducing exposure for one year under a WCPP (Table 8‑14), by use category, exposure type, and cancer site from one year of exposure. As noted above, the microrisk reductions are calculated by combining the changes in the LADCs presented above in Table 8‑5 and Table 8‑10: with the excess cancer risk estimates presented in Table 8‑11. For example, the estimate for the liver microrisk reduction of 0.003 in the Manufacturing row of Table 8‑13 is calculated as 11.19 × 2.76E-10 × 1,000,000.

| Table 8‑13: Reduced Microrisk Per Exposed Individual from Eliminating One Year of Exposure | | | |
| --- | --- | --- | --- |
| Use Category | Exposure Type | Liver Cancer | Lung Cancer |
| Manufacturing | Worker | 0.003 | 0.009 |
| Import/Repackage | Worker | 0.092 | 0.273 |
| Processing as a reactant | Worker | 0.108 | 0.322 |
| Incorporation Into Formulation, Mixture, or Reaction Product | Worker | 0.439 | 1.303 |
| Waste Handling, Disposal, Treatment, and Recycling | Worker | 0.074 | 0.221 |
| Laboratory Use | Worker | 0.068 | 0.203 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Worker | 2.682 | 7.957 |
| Aerospace Paint and Coating Removers | Worker | 1.705 | 5.057 |
| Cellulose Triacetate Film Production | Worker | 2.682 | 7.957 |
| Furniture Refinishing | Worker | 0.552 | 1.638 |
| Glues, Sealants, Adhesives, and Caulks | Worker | 0.485 | 1.439 |
| Batch Vapor Degreasing | Worker | 0.655 | 1.944 |
| Batch Vapor Degreasing | ONU | 0.373 | 1.106 |
| Conveyorized Vapor Degreasing | Worker | 1.545 | 4.584 |
| Conveyorized Vapor Degreasing | ONU | 0.881 | 2.615 |
| Batch Cold Cleaning | Worker | 0.977 | 2.900 |
| Liquid Cleaners and Degreasers (except batch) | Worker | 0.623 | 1.849 |
| Aerosol Spray Cleaning/Degreasing | Worker | 0.100 | 0.297 |
| Aerosol Spray Cleaning/Degreasing | ONU | 0.003 | 0.009 |
| Paint and Coating Removers (Graffiti Removal) | Worker | 0.240 | 0.711 |
| Paint and Coating Removers (Bathtub Refinishing) | Worker | 1.446 | 4.291 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | Worker | 0.233 | 0.692 |
| Paint and Coating Removers (Art Restoration) | Worker | 0.002 | 0.007 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | Worker | 0.215 | 0.637 |
| Paint and Coating Removers (Professional Contracting) | Worker | 1.446 | 4.291 |
| Adhesive and Caulk Remover | Worker | 4.276 | 12.686 |
| Lithographic Printing Cleaner | Worker | 0.108 | 0.321 |
| Dry Cleaning and Spot Removers | Worker | 0.785 | 2.330 |
| Paint and Coatings | Worker | 0.299 | 0.888 |
| Lubricants and Greases | Worker | 0.812 | 2.408 |
| Cold Pipe Insulation | Worker | 0.676 | 2.005 |
| Anti-spatter Welding Aerosol | Worker | 0.623 | 1.849 |

|  |  |  |  |
| --- | --- | --- | --- |
| Table 8‑14: Reduced Microrisk Per Exposed Individual from One Year of Reduced Exposure Under a WCPP | | | |
| Use Category | Exposure Type | Liver Cancer | Lung Cancer |
| Manufacturing | Worker | 0.00100 | 0.00296 |
| Import/Repackage | Worker | 0.08625 | 0.25590 |
| Processing as a reactant | Worker | 0.10434 | 0.30956 |
| Incorporation Into Formulation, Mixture, or Reaction Product | Worker | 0.42957 | 1.27448 |
| Waste Handling, Disposal, Treatment, and Recycling | Worker | 0.06939 | 0.20586 |
| Laboratory Use | Worker | 0.06271 | 0.18605 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Worker | 2.67837 | 7.94637 |
| Aerospace Paint and Coating Removers | Worker | 1.70225 | 5.05037 |
| Cellulose Triacetate Film Production | Worker | 2.67837 | 7.94637 |
| Furniture Refinishing | Worker | 0.54222 | 1.60870 |
| Glues, Sealants, Adhesives, and Caulks | Worker | 0.47797 | 1.41807 |
| Batch Vapor Degreasing | Worker | 0.64457 | 1.91236 |
| Batch Vapor Degreasing | ONU | 0.36340 | 1.07816 |
| Conveyorized Vapor Degreasing | Worker | 1.53810 | 4.56335 |
| Conveyorized Vapor Degreasing | ONU | 0.87076 | 2.58342 |
| Batch Cold Cleaning | Worker | 0.96718 | 2.86951 |
| Liquid Cleaners and Degreasers (except batch)Graffiti | Worker | 0.61538 | 1.82574 |
| Aerosol Spray Cleaning/Degreasing | Worker | 0.09495 | 0.28171 |
| Aerosol Spray Cleaning/Degreasing | ONU | 0.00054 | 0.00161 |
| Paint and Coating Removers (Graffiti Removal) | Worker | 0.23191 | 0.68805 |
| Paint and Coating Removers (Bathtub Refinishing) | Worker | 1.44322 | 4.28186 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | Worker | 0.22243 | 0.65993 |
| Paint and Coating Removers (Art Restoration) | Worker | 0.00000 | 0.00000 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | Worker | 0.20464 | 0.60714 |
| Paint and Coating Removers (Professional Contracting) | Worker | 1.44322 | 4.28186 |
| Adhesive and Caulk Remover | Worker | 4.27016 | 12.66902 |
| Lithographic Printing Cleaner | Worker | 0.10219 | 0.30317 |
| Dry Cleaning and Spot Removers | Worker | 0.78151 | 2.31865 |
| Paint and Coatings | Worker | 0.29043 | 0.86167 |
| Lubricants and Greases | Worker | 0.80297 | 2.38231 |
| Cold Pipe Insulation | Worker | 0.66792 | 1.98163 |
| Anti-spatter Welding Aerosol | Worker | 0.61538 | 1.82574 |

## Value of Microrisk Reductions for Lung and Liver Cancer

Table 8‑15 presents the low and high estimated monetized values for a cancer microrisk reduction by sector, cancer site, and discount rate. The values are estimated from willingness-to-pay values found in the literature ($1.49 to avoid a non-fatal lung cancer microrisk ([Bosworth, Cameron et al. 2009](#_ENREF_7)); $1.26 for the low estimate for avoiding a non-fatal liver cancer microrisk ([Viscusi, Magat et al. 1991](#_ENREF_114)); $7.57 for the high estimate for avoiding a non-fatal liver cancer microrisk ([Magat, Viscusi et al. 1996](#_ENREF_37)); and $12.98 for a mortality microrisk reduction. The value for mortality risk is estimated using EPA’s ([2014a](#_ENREF_86)) recommended value for a statistical life (VSL) of $4.8 million in 1990 dollars and EPA’s ([2014a](#_ENREF_86)) recommended method for adjusting the VSL for income growth and inflation. Specifically, the $4.8 million in 1990 dollars is adjusted for inflation using the CPI (U.S. BLS [2023a](#_ENREF_74)) and then adjusted for income growth using real GDP per capita ([U.S. Bureau of Economic Analysis 2023](#_ENREF_70)) and an income elasticity of 0.4.[[19]](#footnote-21)

As noted in the [Abt Associates (2023b)](#_ENREF_4) report, there is very little peer-reviewed literature available on the timing between exposure and diagnosis and exposure and death (for fatal cancer cases). This timing is important in benefits analysis in order to discount the values of future reduced cancer risks so that they can be compared with costs incurred near the time of exposure. The methods for estimating the timing between exposure, diagnosis, and death (and the probability cancer is fatal), are described in the [Abt Associates (2023b)](#_ENREF_4) report, *Estimated Values of Avoiding Cancer Risks by Cancer Site and Population*. As described in [Abt Associates (2023b)](#_ENREF_4) report, the timing between exposure, diagnosis, and death (for fatal cancer) depend on the age at the time of exposure. Thus, the values differ slightly across the affected population sector because the ages of the populations differ.

| Table 8‑15: Value for Microrisk Reductions (2022$) | | | | | |
| --- | --- | --- | --- | --- | --- |
| Affected Population Sector | Cancer Site | Estimated Value for a 1/1,000,000 Reduction in Cancer Risk | | | |
| Low Estimate | | High Estimate | |
| 7% | 3% | 7% | 3% |
| Manufacturing | C34.9-Lung, NOS | $2.92 | $6.15 | $2.92 | $6.15 |
| Liver | $3.07 | $6.08 | $3.22 | $6.35 |
| Construction | C34.9-Lung, NOS | $2.85 | $6.08 | $2.85 | $6.08 |
| Liver | $3.02 | $6.05 | $3.16 | $6.31 |
| Services | C34.9-Lung, NOS | $2.87 | $6.02 | $2.87 | $6.02 |
| Liver | $2.96 | $5.91 | $3.10 | $6.17 |
| Transportation and public Utilities | C34.9-Lung, NOS | $2.92 | $6.13 | $2.92 | $6.13 |
| Liver | $3.07 | $6.08 | $3.22 | $6.34 |
| Source: Abt Associates 2023b | | | | | |

## Total Benefits from Avoided Cancer Risk and Mortality Risk

Table 8‑16 and Table 8‑17 present the low and high estimates for the total monetized cancer benefits using 3 and 7 percent discount rates respectively, for eliminating occupational exposure. Table 8‑18 and Table 8‑19 present the low and high estimates for the total monetized cancer benefits for 3 and 7 percent discount rates respectively for reducing occupational exposure with a WCPP. Table 8‑20 and Table 8‑21 present the low and high estimates for the total monetized benefits by option and use category, using 3 and 7 percent discount rates respectively. The total benefits presented in Table 8‑20 and Table 8‑21 include the cancer benefits presented in Table 8‑16 through Table 8‑19 and the benefits from avoided mortality risk presented above in section 8.2.

Figure 8‑2 provides an example of the calculations for the steps summarized in Figure 8‑1 and described in the sections above. This example provides the calculations used to arrive at the $11 estimate for the 3% 20-year annualized low benefits estimate for the manufacturing use category shown in Table 8‑20.

| Figure 8‑2: Example Explaining Calculations for the Option 1 Low 3% 20-Year Annualized Value of $11 for the Manufacturing Use Category in Table 8-20 | |
| --- | --- |
| A purple hexagon with white text  Description automatically generated | **Section 8.3**  For example, there are an estimated 533 individuals with baseline exposure in the Manufacturing Use Category (See Table 8‑2). |
| A blue hexagon with white text  Description automatically generated | **Section 8.4**  For example, the baseline exposure for manufacturing is 11.19 ppm (see Table 8‑5). As shown in Table 8‑7, exposure is distributed across workers in three ECEL threshold categories: (1) <Action Level (92% of workers), (2) Between Action Level and Limit (5% of workers), and (3) Between ECEL and 10 times the ECEL (3% of facilities). As indicated in Table 8‑6, workers with exposure between the ECEL and 10 times the ECEL exposure that is 4.8% of their baseline exposure. Given this, the post-compliance exposure under the WCPP is 7.6 (See Table 8‑9; calculated as 5.6\*92% + 45.3\*5% + 126.3\*3%\*4.8%). Thus, the incremental change in exposure is 3.6 ppm (see Table 8‑10; calculated as 11.2 - 7.6). |
| A green hexagon with white text  Description automatically generated | **Section 8.5**  For example, excess risk is 2.76E-10 for liver cancer and 8.20E-10 for lung cancer, as shown in Table 8‑11. |
| An orange hexagon with white text  Description automatically generated | **Section 8.6**  For example, the low estimate for reduced liver cancer risk of 0.00100 shown in Table 8‑14 is calculated as the product of:   * 2.76E-10 (Excess liver cancer estimate shown in Table 8‑11) * 3.61 (the change in exposure, in ppm, from Table 8‑10) * 1,000,000 (to convert from risk to microrisk)   For example, the low estimate for reduced lung cancer risk of 0.00296 shown in Table 8-14 is calculated as the product of:   * 8.20E-10 (Excess lung cancer estimate shown in Table 8‑11) * 3.61 (the change in exposure, in ppm, from Table 8‑10) * 1,000,000 (to convert from risk to microrisk) |
| A grey hexagon with white text  Description automatically generated | **Section 8.7**  For example, for the manufacturing use category, $6.15 is the 3% value used for the low estimate for lung cancer risk and $6.08 is the 3% value used for the low estimate for liver cancer risk (See Table 8‑15). |
| A red and black hexagon with white text  Description automatically generated | **Section 8.8**  For example, the estimated 20-year annualized low estimate for benefits under Option 1 for the manufacturing use category shown in Table 8‑20 is $12. This is calculated using equations 1 and 2 in section 7.2 and the corresponding annual value of $13 shown in Table 8‑18, The $13 includes a benefit of $3 for avoiding liver cancer risk and $10 for avoiding lung cancer risk (also shown in Table 8‑18).  The $3 for avoiding liver cancer risk is calculated as the product of the following:   * 0.00100 (change in microrisk, Table 8‑14) * 533 (individuals affected, Table 8‑2) * $6.08 (low 3% value of microrisk, Table 8‑15)   The $10 for avoiding lung cancer risk is calculated as the product of the following:   * 0.00296 (change in microrisk, Table 8‑14) * 533 (individuals affected, Table 8‑2) * $6.15 (low 3% value of microrisk, Table 8‑15) |

| Table 8‑16: Total Annual Cancer Benefits from Elimination of Occupational Exposure, by Use Category and Exposure Type (3% Discount Rate, 2022$) | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Use Category | Exposure Type | Low Estimate | | | High Estimate | | |
| Liver Cancer | Lung Cancer | Total | Liver Cancer | Lung Cancer | Total |
| Manufacturing | Worker | $10 | $30 | $40 | $10 | $30 | $41 |
| Import/Repackage | Worker | $329 | $987 | $1,315 | $343 | $987 | $1,330 |
| Processing as a reactant | Worker | $463 | $1,391 | $1,854 | $484 | $1,391 | $1,875 |
| Incorporation Into Formulation, Mixture, or Reaction Product | Worker | $828 | $2,485 | $3,313 | $865 | $2,485 | $3,349 |
| Waste Handling, Disposal, Treatment, and Recycling | Worker | $3,393 | $10,182 | $13,575 | $3,544 | $10,182 | $13,726 |
| Laboratory Use | Worker | $76 | $228 | $304 | $79 | $228 | $308 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Worker | $5,740 | $17,226 | $22,965 | $5,995 | $17,226 | $23,220 |
| Aerospace Paint and Coating Removers | Worker | $7,897 | $23,699 | $31,597 | $8,248 | $23,699 | $31,947 |
| Cellulose Triacetate Film Production | Worker | $82 | $245 | $326 | $85 | $245 | $330 |
| Furniture Refinishing | Worker | $37,929 | $114,625 | $152,554 | $39,598 | $114,625 | $154,223 |
| Glues, Sealants, Adhesives, and Caulks | Worker | $120,503 | $361,635 | $482,138 | $125,855 | $361,635 | $487,489 |
| Batch Vapor Degreasing | Worker | $274 | $821 | $1,095 | $286 | $821 | $1,107 |
| Batch Vapor Degreasing | ONU | $92 | $276 | $368 | $96 | $276 | $372 |
| Conveyorized Vapor Degreasing | Worker | $20 | $60 | $80 | $21 | $60 | $81 |
| Conveyorized Vapor Degreasing | ONU | $7 | $20 | $27 | $7 | $20 | $27 |
| Batch Cold Cleaning | Worker | $4,405 | $13,134 | $17,539 | $4,594 | $13,134 | $17,728 |
| Liquid Cleaners and Degreasers (except batch)Graffiti | Worker | $53,356 | $159,087 | $212,443 | $55,650 | $159,087 | $214,736 |
| Aerosol Spray Cleaning/Degreasing | Worker | $316,829 | $944,654 | $1,261,483 | $330,445 | $944,654 | $1,275,099 |
| Aerosol Spray Cleaning/Degreasing | ONU | $1,069 | $3,188 | $4,258 | $1,115 | $3,188 | $4,304 |
| Paint and Coating Removers (Graffiti Removal) | Worker | $4,556 | $13,585 | $18,142 | $4,752 | $13,585 | $18,337 |
| Paint and Coating Removers (Bathtub Refinishing) | Worker | $6,344 | $18,916 | $25,261 | $6,617 | $18,916 | $25,533 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | Worker | $17,384 | $52,535 | $69,918 | $18,148 | $52,535 | $70,683 |
| Paint and Coating Removers (Art Restoration) | Worker | $1 | $2 | $3 | $1 | $2 | $3 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | Worker | $4,788 | $14,368 | $19,156 | $5,000 | $14,368 | $19,368 |
| Paint and Coating Removers (Professional Contracting) | Worker | $13,441 | $40,076 | $53,518 | $14,019 | $40,076 | $54,095 |
| Adhesive and Caulk Remover | Worker | $1,261,481 | $3,785,744 | $5,047,224 | $1,317,500 | $3,785,744 | $5,103,244 |
| Lithographic Printing Cleaner | Worker | $1,755 | $5,267 | $7,022 | $1,833 | $5,267 | $7,100 |
| Dry Cleaning and Spot Removers | Worker | $13,334 | $40,015 | $53,348 | $13,926 | $40,015 | $53,940 |
| Paint and Coatings | Worker | $1,453 | $4,362 | $5,815 | $1,518 | $4,362 | $5,880 |
| Lubricants and Greases | Worker | $231,781 | $695,582 | $927,363 | $242,074 | $695,582 | $937,656 |
| Cold Pipe Insulation | Worker | $191,183 | $573,747 | $764,931 | $199,673 | $573,747 | $773,421 |
| Anti-spatter Welding Aerosol | Worker | $56,140 | $168,478 | $224,619 | $58,633 | $168,478 | $227,112 |

| Table 8‑17: Total Annual Cancer Benefits from Elimination of Occupational Exposure, by Use Category and Exposure Type (7% Discount Rate, $2022) | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Use Category | Exposure Type | Low Estimate | | | High Estimate | | |
| Liver Cancer | Lung Cancer | Total | Liver Cancer | Lung Cancer | Total |
| Manufacturing | Worker | $5 | $14 | $19 | $5 | $14 | $20 |
| Import/Repackage | Worker | $166 | $468 | $634 | $174 | $468 | $643 |
| Processing as a reactant | Worker | $234 | $660 | $894 | $245 | $660 | $906 |
| Incorporation Into Formulation, Mixture, or Reaction Product | Worker | $418 | $1,180 | $1,598 | $438 | $1,180 | $1,618 |
| Waste Handling, Disposal, Treatment, and Recycling | Worker | $1,713 | $4,835 | $6,548 | $1,797 | $4,835 | $6,631 |
| Laboratory Use | Worker | $38 | $108 | $147 | $40 | $108 | $149 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Worker | $2,898 | $8,179 | $11,077 | $3,040 | $8,179 | $11,218 |
| Aerospace Paint and Coating Removers | Worker | $3,988 | $11,252 | $15,240 | $4,182 | $11,252 | $15,435 |
| Cellulose Triacetate Film Production | Worker | $41 | $116 | $157 | $43 | $116 | $159 |
| Furniture Refinishing | Worker | $18,997 | $54,647 | $73,643 | $19,895 | $54,647 | $74,542 |
| Glues, Sealants, Adhesives, and Caulks | Worker | $60,846 | $171,703 | $232,549 | $63,819 | $171,703 | $235,522 |
| Batch Vapor Degreasing | Worker | $139 | $391 | $530 | $145 | $391 | $536 |
| Batch Vapor Degreasing | ONU | $47 | $132 | $178 | $49 | $132 | $180 |
| Conveyorized Vapor Degreasing | Worker | $10 | $29 | $39 | $11 | $29 | $39 |
| Conveyorized Vapor Degreasing | ONU | $3 | $10 | $13 | $4 | $10 | $13 |
| Batch Cold Cleaning | Worker | $2,199 | $6,156 | $8,355 | $2,301 | $6,156 | $8,457 |
| Liquid Cleaners and Degreasers (except batch)Graffiti | Worker | $26,634 | $74,572 | $101,206 | $27,869 | $74,572 | $102,441 |
| Aerosol Spray Cleaning/Degreasing | Worker | $158,153 | $442,806 | $600,959 | $165,484 | $442,806 | $608,291 |
| Aerosol Spray Cleaning/Degreasing | ONU | $534 | $1,494 | $2,028 | $559 | $1,494 | $2,053 |
| Paint and Coating Removers (Graffiti Removal) | Worker | $2,274 | $6,368 | $8,642 | $2,380 | $6,368 | $8,748 |
| Paint and Coating Removers (Bathtub Refinishing) | Worker | $3,167 | $8,867 | $12,034 | $3,314 | $8,867 | $12,181 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | Worker | $8,707 | $25,046 | $33,752 | $9,118 | $25,046 | $34,164 |
| Paint and Coating Removers (Art Restoration) | Worker | $0 | $1 | $2 | $0 | $1 | $2 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | Worker | $2,417 | $6,822 | $9,239 | $2,536 | $6,822 | $9,358 |
| Paint and Coating Removers (Professional Contracting) | Worker | $6,710 | $18,786 | $25,495 | $7,021 | $18,786 | $25,806 |
| Adhesive and Caulk Remover | Worker | $636,965 | $1,797,459 | $2,434,423 | $668,087 | $1,797,459 | $2,465,546 |
| Lithographic Printing Cleaner | Worker | $886 | $2,501 | $3,387 | $930 | $2,501 | $3,430 |
| Dry Cleaning and Spot Removers | Worker | $6,733 | $18,999 | $25,731 | $7,062 | $18,999 | $26,060 |
| Paint and Coatings | Worker | $734 | $2,071 | $2,805 | $770 | $2,071 | $2,841 |
| Lubricants and Greases | Worker | $117,034 | $330,260 | $447,294 | $122,752 | $330,260 | $453,012 |
| Cold Pipe Insulation | Worker | $96,535 | $272,413 | $368,948 | $101,252 | $272,413 | $373,665 |
| Anti-spatter Welding Aerosol | Worker | $28,347 | $79,993 | $108,340 | $29,732 | $79,993 | $109,725 |

| Table 8‑18: Total Annual Cancer Benefits from Reducing Occupational Exposure with an ECEL, by Use Category and Exposure Type (3% Discount Rate, $2022) | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Use Category | Exposure Type | Low Estimate | | | High Estimate | | |
| Liver Cancer | Lung Cancer | Total | Liver Cancer | Lung Cancer | Total |
| Manufacturing | Worker | $3 | $10 | $13 | $3 | $10 | $13 |
| Import/Repackage | Worker | $308 | $924 | $1,232 | $321 | $924 | $1,245 |
| Processing as a reactant | Worker | $446 | $1,338 | $1,784 | $466 | $1,338 | $1,804 |
| Incorporation Into Formulation, Mixture, or Reaction Product | Worker | $810 | $2,430 | $3,239 | $846 | $2,430 | $3,275 |
| Waste Handling, Disposal, Treatment, and Recycling | Worker | $3,161 | $9,486 | $12,647 | $3,301 | $9,486 | $12,788 |
| Laboratory Use | Worker | $70 | $209 | $279 | $73 | $209 | $282 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Worker | $5,732 | $17,202 | $22,934 | $5,987 | $17,202 | $23,189 |
| Aerospace Paint and Coating Removers | Worker | $7,886 | $23,668 | $31,554 | $8,237 | $23,668 | $31,904 |
| Cellulose Triacetate Film Production | Worker | $81 | $244 | $326 | $85 | $244 | $329 |
| Furniture Refinishing | Worker | $37,253 | $112,581 | $149,833 | $38,891 | $112,581 | $151,472 |
| Glues, Sealants, Adhesives, and Caulks | Worker | $118,746 | $356,362 | $475,108 | $124,020 | $356,362 | $480,381 |
| Batch Vapor Degreasing | Worker | $270 | $807 | $1,077 | $281 | $807 | $1,089 |
| Batch Vapor Degreasing | ONU | $90 | $269 | $359 | $94 | $269 | $363 |
| Conveyorized Vapor Degreasing | Worker | $20 | $60 | $80 | $21 | $60 | $80 |
| Conveyorized Vapor Degreasing | ONU | $7 | $20 | $27 | $7 | $20 | $27 |
| Batch Cold Cleaning | Worker | $4,359 | $12,998 | $17,357 | $4,547 | $12,998 | $17,544 |
| Liquid Cleaners and Degreasers (except batch) | Worker | $52,699 | $157,128 | $209,827 | $54,964 | $157,128 | $212,092 |
| Aerosol Spray Cleaning/Degreasing | Worker | $300,504 | $895,979 | $1,196,483 | $313,418 | $895,979 | $1,209,397 |
| Aerosol Spray Cleaning/Degreasing | ONU | $191 | $570 | $761 | $199 | $570 | $769 |
| Paint and Coating Removers (Graffiti Removal) | Worker | $4,411 | $13,152 | $17,564 | $4,601 | $13,152 | $17,753 |
| Paint and Coating Removers (Bathtub Refinishing) | Worker | $6,330 | $18,874 | $25,205 | $6,602 | $18,874 | $25,477 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | Worker | $16,589 | $50,133 | $66,722 | $17,319 | $50,133 | $67,451 |
| Paint and Coating Removers (Art Restoration) | Worker | $0 | $0 | $0 | $0 | $0 | $0 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | Worker | $4,560 | $13,685 | $18,245 | $4,763 | $13,685 | $18,447 |
| Paint and Coating Removers (Professional Contracting) | Worker | $13,412 | $39,988 | $53,399 | $13,988 | $39,988 | $53,976 |
| Adhesive and Caulk Remover | Worker | $1,259,782 | $3,780,645 | $5,040,426 | $1,315,726 | $3,780,645 | $5,096,370 |
| Lithographic Printing Cleaner | Worker | $1,660 | $4,982 | $6,642 | $1,734 | $4,982 | $6,716 |
| Dry Cleaning and Spot Removers | Worker | $13,266 | $39,813 | $53,079 | $13,856 | $39,813 | $53,669 |
| Paint and Coatings | Worker | $1,411 | $4,234 | $5,645 | $1,474 | $4,234 | $5,708 |
| Lubricants and Greases | Worker | $229,295 | $688,122 | $917,418 | $239,478 | $688,122 | $927,600 |
| Cold Pipe Insulation | Worker | $188,919 | $566,952 | $755,872 | $197,309 | $566,952 | $764,261 |
| Anti-spatter Welding Aerosol | Worker | $55,449 | $166,404 | $221,853 | $57,911 | $166,404 | $224,315 |

| Table 8‑19: Total Annual Cancer Benefits from Reducing Occupational Exposure with an ECEL, by Use Category and Exposure Type (7% Discount Rate, $2022) | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Use Category | Exposure Type | Low Estimate | | | High Estimate | | |
| Liver Cancer | Lung Cancer | Total | Liver Cancer | Lung Cancer | Total |
| Manufacturing | Worker | $2 | $5 | $6 | $2 | $5 | $6 |
| Import/Repackage | Worker | $155 | $439 | $594 | $163 | $439 | $602 |
| Processing as a reactant | Worker | $225 | $635 | $861 | $236 | $635 | $872 |
| Incorporation Into Formulation, Mixture, or Reaction Product | Worker | $409 | $1,154 | $1,562 | $429 | $1,154 | $1,582 |
| Waste Handling, Disposal, Treatment, and Recycling | Worker | $1,596 | $4,504 | $6,100 | $1,674 | $4,504 | $6,178 |
| Laboratory Use | Worker | $35 | $99 | $135 | $37 | $99 | $136 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | Worker | $2,894 | $8,168 | $11,062 | $3,036 | $8,168 | $11,203 |
| Aerospace Paint and Coating Removers | Worker | $3,982 | $11,237 | $15,219 | $4,177 | $11,237 | $15,414 |
| Cellulose Triacetate Film Production | Worker | $41 | $116 | $157 | $43 | $116 | $159 |
| Furniture Refinishing | Worker | $18,658 | $53,672 | $72,330 | $19,540 | $53,672 | $73,212 |
| Glues, Sealants, Adhesives, and Caulks | Worker | $59,959 | $169,199 | $229,158 | $62,889 | $169,199 | $232,088 |
| Batch Vapor Degreasing | Worker | $136 | $385 | $521 | $143 | $385 | $528 |
| Batch Vapor Degreasing | ONU | $45 | $128 | $174 | $48 | $128 | $176 |
| Conveyorized Vapor Degreasing | Worker | $10 | $28 | $38 | $11 | $28 | $39 |
| Conveyorized Vapor Degreasing | ONU | $3 | $10 | $13 | $4 | $10 | $13 |
| Batch Cold Cleaning | Worker | $2,176 | $6,093 | $8,269 | $2,277 | $6,093 | $8,370 |
| Liquid Cleaners and Degreasers (except batch) | Worker | $26,306 | $73,654 | $99,960 | $27,526 | $73,654 | $101,179 |
| Aerosol Spray Cleaning/Degreasing | Worker | $150,004 | $419,990 | $569,994 | $156,958 | $419,990 | $576,948 |
| Aerosol Spray Cleaning/Degreasing | ONU | $95 | $267 | $363 | $100 | $267 | $367 |
| Paint and Coating Removers (Graffiti Removal) | Worker | $2,202 | $6,165 | $8,367 | $2,304 | $6,165 | $8,469 |
| Paint and Coating Removers (Bathtub Refinishing) | Worker | $3,160 | $8,847 | $12,007 | $3,306 | $8,847 | $12,154 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | Worker | $8,308 | $23,901 | $32,209 | $8,701 | $23,901 | $32,602 |
| Paint and Coating Removers (Art Restoration) | Worker | $0 | $0 | $0 | $0 | $0 | $0 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | Worker | $2,303 | $6,498 | $8,800 | $2,415 | $6,498 | $8,913 |
| Paint and Coating Removers (Professional Contracting) | Worker | $6,695 | $18,744 | $25,439 | $7,005 | $18,744 | $25,749 |
| Adhesive and Caulk Remover | Worker | $636,107 | $1,795,038 | $2,431,145 | $667,187 | $1,795,038 | $2,462,225 |
| Lithographic Printing Cleaner | Worker | $838 | $2,365 | $3,204 | $879 | $2,365 | $3,245 |
| Dry Cleaning and Spot Removers | Worker | $6,699 | $18,903 | $25,602 | $7,026 | $18,903 | $25,929 |
| Paint and Coatings | Worker | $712 | $2,010 | $2,723 | $747 | $2,010 | $2,758 |
| Lubricants and Greases | Worker | $115,779 | $326,718 | $442,497 | $121,436 | $326,718 | $448,154 |
| Cold Pipe Insulation | Worker | $95,392 | $269,187 | $364,579 | $100,053 | $269,187 | $369,240 |
| Anti-spatter Welding Aerosol | Worker | $27,998 | $79,008 | $107,006 | $29,366 | $79,008 | $108,374 |

| Table 8‑20: Total Monetized Benefits by Use Category and Option (20-Year Annualized using 3 Percent Discount Rate, 2022$) | | | | |
| --- | --- | --- | --- | --- |
| Use Category | Low Estimate | | High Estimate | |
| Option 1  (Final Rule) | Option 2  (Alternative) | Option 1  (Final Rule) | Option 2  (Alternative) |
| Manufacturing | $12 | $12 | $12 | $12 |
| Import/Repackage | $1,154 | $1,154 | $1,167 | $1,167 |
| Processing as a reactant | $1,672 | $1,672 | $1,691 | $1,691 |
| Incorporation Into Formulation, Mixture, or Reaction Product | $3,095 | $3,095 | $3,129 | $3,129 |
| Waste Handling, Disposal, Treatment, and Recycling | $11,851 | $11,851 | $11,982 | $11,982 |
| Laboratory Use | $262 | $262 | $264 | $264 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | $21,490 | $21,519 | $21,758 | $21,728 |
| Aerospace Paint and Coating Removers | $29,567 | $29,584 | $29,912 | $29,895 |
| Cellulose Triacetate Film Production | $306 | $305 | $309 | $309 |
| Furniture Refinishing | $142,031 | $140,888 | $142,429 | $143,584 |
| Glues, Sealants, Adhesives, and Caulks | $192,742 | $451,772 | $456,786 | $194,882 |
| Vapor Degreasing | $1,472 | $1,472 | $1,487 | $1,487 |
| Liquid Cleaners and Degreasers | $215,497 | $215,497 | $217,823 | $217,823 |
| Aerosol Spray Cleaning/Degreasing | $1,186,021 | $1,186,021 | $1,198,823 | $1,198,823 |
| Paint and Coating Removers (Graffiti Removal) | $16,999 | $16,999 | $17,182 | $17,182 |
| Paint and Coating Removers (Bathtub Refinishing) | $5,224,687 | $5,224,687 | $5,224,942 | $5,224,942 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | $65,515 | $65,515 | $66,231 | $66,231 |
| Paint and Coating Removers (Art Restoration) | $3 | $3 | $3 | $3 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | $17,949 | $17,949 | $18,149 | $18,149 |
| Paint and Coating Removers (Professional Contracting) | $11,069,130 | $11,069,130 | $11,069,671 | $11,069,671 |
| Adhesive and Caulk Remover | $4,729,338 | $4,729,338 | $4,781,830 | $4,781,830 |
| Lithographic Printing Cleaner | $6,580 | $6,580 | $6,653 | $6,653 |
| Dry Cleaning and Spot Removers | $49,988 | $49,988 | $50,543 | $50,543 |
| Paint and Coatings | $5,449 | $5,449 | $5,509 | $5,509 |
| Lubricants and Greases | $868,955 | $868,955 | $878,600 | $878,600 |
| Cold Pipe Insulation | $716,754 | $716,754 | $724,709 | $724,709 |
| Anti-spatter Welding Aerosol | $210,472 | $210,472 | $212,808 | $212,808 |
| **Total** | **$24,788,990** | **$25,046,923** | **$25,144,404** | **$24,883,608** |

| Table 8‑21: Total Monetized Benefits by Use Category and Option (20-Year Annualized using 7 Percent Discount Rate, 2022$) | | | | |
| --- | --- | --- | --- | --- |
| Use Category | Low Estimate | | High Estimate | |
| Option 1  (Final Rule) | Option 2  (Alternative) | Option 1  (Final Rule) | Option 2  (Alternative) |
| Manufacturing | $6 | $6 | $6 | $6 |
| Import/Repackage | $543 | $543 | $550 | $550 |
| Processing as a reactant | $786 | $786 | $796 | $796 |
| Incorporation Into Formulation, Mixture, or Reaction Product | $1,456 | $1,456 | $1,474 | $1,474 |
| Waste Handling, Disposal, Treatment, and Recycling | $5,574 | $5,574 | $5,645 | $5,645 |
| Laboratory Use | $123 | $123 | $125 | $125 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | $10,108 | $10,121 | $10,251 | $10,237 |
| Aerospace Paint and Coating Removers | $13,907 | $13,913 | $14,091 | $14,085 |
| Cellulose Triacetate Film Production | $144 | $144 | $145 | $146 |
| Furniture Refinishing | $66,750 | $66,434 | $67,244 | $67,564 |
| Glues, Sealants, Adhesives, and Caulks | $71,615 | $212,492 | $215,208 | $72,530 |
| Vapor Degreasing | $694 | $694 | $703 | $703 |
| Liquid Cleaners and Degreasers | $100,112 | $100,112 | $101,333 | $101,333 |
| Aerosol Spray Cleaning/Degreasing | $550,979 | $550,979 | $557,701 | $557,701 |
| Paint and Coating Removers (Graffiti Removal) | $7,897 | $7,897 | $7,993 | $7,993 |
| Paint and Coating Removers (Bathtub Refinishing) | $5,080,545 | $5,080,545 | $5,080,679 | $5,080,679 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | $30,841 | $30,841 | $31,217 | $31,217 |
| Paint and Coating Removers (Art Restoration) | $1 | $1 | $1 | $1 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | $8,443 | $8,443 | $8,550 | $8,550 |
| Paint and Coating Removers (Professional Contracting) | $10,763,747 | $10,763,747 | $10,764,032 | $10,764,032 |
| Adhesive and Caulk Remover | $2,224,451 | $2,224,451 | $2,252,889 | $2,252,889 |
| Lithographic Printing Cleaner | $3,095 | $3,095 | $3,135 | $3,135 |
| Dry Cleaning and Spot Removers | $23,512 | $23,512 | $23,813 | $23,813 |
| Paint and Coatings | $2,563 | $2,563 | $2,596 | $2,596 |
| Lubricants and Greases | $408,714 | $408,714 | $413,939 | $413,939 |
| Cold Pipe Insulation | $337,126 | $337,126 | $341,436 | $341,436 |
| Anti-spatter Welding Aerosol | $98,996 | $98,996 | $100,261 | $100,261 |
| **Total** | **$19,812,726** | **$19,953,307** | **$20,005,814** | **$19,863,436** |

## Qualitative Discussion of the Benefits of Non-Cancer Risk Reductions

While the benefits analysis can only quantify and monetize reduced risk of cancer, the exposure values described in section 8.4 would also result in reduced non-cancer effects. The risk assessment approach used in the Risk Evaluation ([EPA 2020i](#_ENREF_104)) identifies unreasonable risk and provides information needed to establish a protective level of exposures. However, the approach does not provide the continuous dose-response function needed to quantify changes in incidence of non-cancer effects in exposed populations, and therefore, while non-cancer benefits are expected from the rule, these effects cannot be quantitatively included in the benefit-cost analysis.

In the Risk Evaluation, EPA identified potential cancer and non-cancer human health risks. Risks from acute exposures include central nervous system risks such as central nervous system depression and a decrease in peripheral vision, each of which can lead to workplace accidents and which are precursors to more severe central nervous system effects such as incapacitation, loss of consciousness, and death. The reduced mortality benefits from reductions in acute exposures are estimated and described in Section 8.2. Table 8‑22 presents an overview of the benefits considered in the economic analysis. As noted in the table, three benefit endpoints are discussed qualitatively in this section.

|  |  |  |
| --- | --- | --- |
| Table 8‑22: Overview of Benefits Considered in Benefits Analysis | | |
| **Health Endpoint** | **Benefits Considered in This Analysis** | **Section** |
| Mortality risk from acute exposures | Monetized benefits of avoided mortality risk | Section 8.2 and 8.8 |
| Liver cancer | Monetized benefits of avoided cancer risk | Sections 8.3-8.8 |
| Lung cancer |
| Fatty liver disease | Qualitative discussion of benefits. Supported by animal studies. Potentially large dollar-valued benefits. | This section (8.9) |
| Nervous system effects | Qualitative discussion of benefits. Support from human and animal studies. Magnitude of potential benefits unknown. |
| Kidney toxicity | Qualitative discussion of benefits. Support from animal studies. Magnitude of potential benefits unknown. |
| Reproductive and developmental hazards | Qualitative discussion of benefits. Support from animal studies. Magnitude of potential benefits unknown. |

### Fatty liver disease

For chronic exposures, EPA evaluated risk of several adverse health outcomes, but the unreasonable risk determination was often based on chronic inhalation exposures and associated non-cancer liver effects including vacuolization, necrosis, hemosiderosis and hepatocellular degeneration ([EPA 2020i](#_ENREF_104)). The risk evaluation also noted that fatty liver, a more severe effect compared with vacuolization, was seen in rats and dogs ([Haun et al. 1971](#_ENREF_24); [1972](#_ENREF_25)) and that oral studies have also identified fatty liver in mice and rats ([Serota, Thakur et al. 1986a](#_ENREF_62); [1986b](#_ENREF_63)). These fatty liver changes can be considered a progression from vacuolization, something that has led EPA to suggest that vacuolization should be considered toxicologically adverse and not simply an adaptive change ([EPA 2011b](#_ENREF_84)).

Given the evidence in the risk evaluation, it is reasonable to conclude that reductions in chronic exposures to methylene chloride may produce benefits from reduced incidence of fatty liver disease. While the magnitude of these benefits cannot be quantified, information on the costs of fatty liver disease provides some perspective on whether those benefits might be significant.

While willingness to pay (WTP) is the appropriate valuation measure for reduced health risk in benefit-cost analysis ([EPA 2014a](#_ENREF_86)), no WTP estimates for reducing the risk of fatty liver disease appear to exist in the economics literature. Two recent cost-of-illness studies of the costs of non-alcoholic fatty liver disease (NAFLD) are described here. NAFLD is likely to be more reflective of the effect of methylene chloride than alcoholic fatty liver disease, which results from heavy alcohol use. These studies reflect the general findings in the literature that NAFLD can have substantial direct and indirect costs.

[Hirode, Saab et al. (2020)](#_ENREF_26) evaluates hospitalization costs related to chronic liver disease between 2012 and 2016 using a large, nationally representative sample. The study breaks out hospitalizations and costs for a several etiologies of chronic liver disease, including NAFLD. There were approximately 201,000 hospitalizations for NAFLD over this time period, or about 50,000 per year. Approximately 4.1 percent of these hospitalizations, or just over 2,000, resulted in in-hospital mortality. Mean costs per hospitalization for NAFLD were $13,500 per case over this time period (2016$) and the total costs were approximately $2.5 billion, or about $500 million per year.

[Younossi, Blissett et al. (2016)](#_ENREF_117) takes a broader look at the cost of NAFLD, estimating the annual economic burden for all cases of NAFLD in the United States, rather than just the cost of hospitalization. Predicted incident cases of NAFLD are estimated at over 12 million per year, and the annual direct medical costs are about $103 billion ($1,612 per patient) based on Medicare cost data. Costs are highest in patients aged 45-65. Younossi et al. also calculates and reports additional annual societal costs of $188 billion, but this is based on monetizing quality adjusted life-years (QALYs), which is not a recommended best practice for benefit-cost analysis ([Institute of Medicine 2006](#_ENREF_32); [EPA 2014a](#_ENREF_86)). Still, it should be recognized that the direct costs do omit non-pecuniary costs such as pain and suffering which may be substantial.

Other studies show similar results for specific populations. For example, [Sayiner, Otgonsuren et al. (2017)](#_ENREF_61) estimates payments per hospitalization for NAFLD among a sample of 2010 Medicare patients of $10,000 - $18,000, and outpatient payments of about $2000.

None of these studies provides the cost-of-illness estimate most needed to evaluate the benefits of reduced fatty liver disease even if changes in risk were quantified. Because the benefits would come in changes in incidence of NAFLD, the most appropriate cost-of-illness estimate would be the expected (discounted) lifetime costs of newly-diagnosed cases. This estimate would reflect expected hospitalization and outpatient costs per case and would consider the likely course of the disease and the probability of requiring different types of care. Still, existing studies on the costs of NAFLD show that the costs are not trivial, and that the reductions in chronic exposure to methylene chloride under this rule would provide benefits in terms of reducing treatment costs.

### Nervous system effects

The 2014 methylene chloride risk assessment and EPA's 2011 IRIS assessment identified nervous system effects as the critical effect of greatest concern for acute exposure to methylene chloride. Specifically, these assessments identified sensory impairment and incapacitation (loss of consciousness) as the critical effect of acute exposures ([EPA 2014b](#_ENREF_87), [2011b](#_ENREF_84)). Exposure to methylene chloride can rapidly cause death as a result of nervous system depression, but even exposures that may in some cases result only in dizziness or fainting can be fatal if the individual who is disoriented or has fainted is alone. Several individuals have died after becoming incapacitated while using products containing methylene chloride. After losing consciousness, their nervous system is overcome by the continued accumulation of volatile fumes. As described in a report on deaths caused by methylene chloride, “. . . the danger posed by methylene chloride is its one-two punch when fumes accumulate. Because it turns into carbon monoxide in the body, it can starve the heart of oxygen and prompt an attack. The chemical also acts as an anesthetic at high doses: Its victims slump over, no longer breathing, because the respiratory centers of their brains switch off.” ([Hopkins 2015](#_ENREF_28)).

Although the fact that deaths occur as a result of exposure to methylene chloride is well documented, the exact number of deaths specifically attributable to methylene exposure is unclear. To the extent practicable, EPA monetized the potential fatalities avoided by reducing acute exposure to methylene chloride as discussed in section 8.2. These deaths clearly have a significant impact on families, workplaces, and communities, and yet not all of them can be monetized. Similarly, the serious health effects and lifetime impacts on workers who do not die but who are hospitalized with heart failure, coma, or other effects also cannot be quantified or monetized ([EPA 2014b](#_ENREF_87)). Even when less severe, the nervous system effects of acute exposure to methylene chloride can have considerable adverse consequences on an individual, particularly if one is exposed as a bystander who is unaware of why these nervous system effects are occurring.

In addition to acute exposure concerns, there are CNS chronic exposure concerns related to cognitive impairment (affecting eye-hand coordination, tracking tasks, auditory vigilance); adverse effects on autonomic, neuromuscular, and sensorimotor functions ([EPA 2014b](#_ENREF_87)); and long-term effects on specific cognitive-neurological measures (*i.e.,* attention and reaction time) ([EPA 2011b](#_ENREF_84)). These potential health impacts may result in an increase in workplace injuries due to worker impairment.

### Kidney toxicity

EPA's 2011 IRIS assessment for methylene chloride identified kidney effects from exposure to methylene chloride; these effects include renal tubular degeneration ([EPA 2011b](#_ENREF_84)). At very high exposures, chronic inhalation exposure to methylene chloride during paint and coating removal can result in kidney toxicity.

Exposure to methylene chloride can lead to changes in the proximal tubules of the kidney. This damage may result in signs and symptoms of acute kidney failure that include: decreased urine output, although occasionally urine output remains normal; fluid retention, causing swelling in the legs, ankles or feet; drowsiness; shortness of breath; fatigue; confusion; nausea; seizures or coma in severe cases; and chest pain or pressure. Sometimes acute kidney failure causes no signs or symptoms and is detected through lab tests done for another reason.

Kidney toxicity means the kidney has suffered damage that can result in a person being unable to rid their body of excess urine and wastes. In extreme cases where the kidney is impaired over a long period of time, the kidney could be damaged to the point that it no longer functions. When a kidney no longer functions, a person needs dialysis and ideally a kidney transplant. In some cases, a non-functioning kidney can result in death. Kidney dialysis and kidney transplantation are expensive and incur long-term health costs if kidney function fails ([Mayo Clinic 2015](#_ENREF_40)).

Depending on the severity of the kidney damage, kidney disease can impact a person's ability to work and live a normal life, which in turn takes a mental and emotional toll on the patient. In less severe cases, the impact on a person's quality of life may be limited, while in instances where kidney damage is severe, a person's quality of life and ability to work would be affected. While neither the precise reduction in individual risk of developing kidney toxicity from reducing exposure to methylene chloride total number of cases avoided can be estimated, these impacts must still be considered because they can significantly affect those exposed to methylene chloride.

### Reproductive and Developmental Hazards

The 2020 Risk Evaluation for Methylene Chloride identified two non-cancer health effects in reviewed scientific literature relevant to children, namely reproductive and developmental hazards ([EPA 2020i](#_ENREF_104)). The 2020 Risk Evaluation for Methylene Chloride summarizes human health hazards identified in the review of scientific literature, including studies investigating methylene chloride exposure and reproductive and developmental effects as well as developmental neurotoxicity. Some epidemiological studies identified effects that include reduced fertility, spontaneous abortions, oral cleft defects, heart defects, and autism spectrum disorder (ASD). For ASD, due to methodological reasons including confounding by other chemicals and lack of temporal specificity, the 2020 Risk Evaluation for Methylene Chloride did not advance this hazard to a dose response calculation. Additionally, EPA did not carry reproductive/developmental effects forward for dose-response, because epidemiological studies lacked controls for co-exposures, animal studies observed effects mostly at higher methylene chloride concentrations, and EPA identified no relevant mechanistic information ([EPA 2020i](#_ENREF_104)). Nonetheless, additional health benefits may be achieved by reducing the incidence of reproductive effects for workers in commercial facilities or companies that use methylene chloride for the commercial uses proposed to be regulated.

EPA was unable to estimate either the precise reduction in individual risk of these reproductive and developmental effects from reducing exposure to methylene chloride or the total number of cases avoided can be estimated due to a lack of necessary data. Nevertheless, reproductive hazards such as reduced fertility are important considerations. These health effects are serious and can have impacts throughout a lifetime; for example, infertility and fertility treatment can have deleterious social and psychological consequences such as mental distress ([Cousineau and Domar 2007](#_ENREF_16)).

The potential impacts of these effects include monetary impacts from associated healthcare costs such as fertility treatments, as well as complications from fertility treatments (e.g., higher multiple birth rates), mental stress and emotional suffering, which cannot be quantified or monetized but should not be ignored.

# Comparison of Costs and Benefits and Monetized Net Benefits

This chapter presents estimates for the quantified net benefits of the options. Costs, benefits, and net benefits are presented in 2022$ in this document unless otherwise noted. Annualized quantified net benefits are estimated by subtracting the total annualized quantified cost of the options (see Chapter 7) from the total annualized quantified benefits (see Chapter 8). Total annualized quantified costs reflect costs of compliance with the options, including costs associated with complying with prohibition and WCPP requirements, for those uses where costs could be estimated. Total annualized quantified benefits reflect the benefits of reduced risk for liver and lung cancer and reduced mortality risk from acute exposure to methylene chloride paint removers.

Table 9‑1 presents the undiscounted stream of annual costs, benefits, and net benefits over the 20-year analytical timeframe. Note that year “0” costs are the initial costs and year “1” costs are recurring costs incurred in the first year.

Table 9‑2 and Table 9‑3 present the net benefits by use category estimated using a 3 percent discount rate using the low and high benefits estimates, respectively. Table 9‑4 and Table 9‑5 present the net benefits by use category estimated using a 7 percent discount rate using the low and high benefits estimates, respectively. Table 9‑6 summarizes the four net benefits estimates that were estimated.

Chapter 7, section 7.12, includes a discussion of the unquantified costs. Similarly, Chapter 8 notes that there are also unquantified benefits associated with reduced health risks in addition to cancer. Therefore, it is not clear whether the monetized net benefits presented in the tables below under- or over-estimate the true social net benefits of the options.

In addition to analyzing the net benefits, EPA is required to consider the cost effectiveness of the options. Cost effectiveness is a method of comparing certain actions in terms of the expense per item of interest or goal. A goal of this regulatory action is to prevent user deaths resulting from exposure to methylene chloride. The final rule regulatory option costs $27 million per potential prevented death while the alternative option costs $151 million per potential prevented death (using the 3 percent discount rate), indicating that the final rule option is more cost effective compared to the alternative option.

| Table 9‑1: 20-Year Stream of Annual Undiscounted Costs, Benefits, and Net Benefits (millions, 2022$) | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | Costs | | Benefits | | | | Net Benefits | | | |
| Low Estimate | | High Estimate | | Low Estimate | | High Estimate | |
| Option 1  (Final Rule) | Option 2  (Alternative) | Option 1  (Final Rule) | Option 2  (Alternative) | Option 1  (Final Rule) | Option 2  (Alternative) | Option 1  (Final Rule) | Option 2  (Alternative) | Option 1  (Final Rule) | Option 2  (Alternative) |
| 0 | $140 | $2,785 | - | - | - | - | ($140) | ($2,785) | ($140) | ($2,785) |
| 1 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 2 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 3 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 4 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 5 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 6 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 7 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 8 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 9 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 10 | $35 | $29 | $22 | $22 | $27 | $27 | ($13) | ($7) | ($8) | ($2) |
| 11 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 12 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 13 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 14 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 15 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 16 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 17 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 18 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 19 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |
| 20 | $30 | $29 | $22 | $22 | $27 | $27 | ($8) | ($7) | ($3) | ($2) |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 9‑2: Total 20-Year Annualized Net Benefits by Use Category and Option (Low Benefits Estimate, 3 Percent Discount Rate, 2022$) | | | | | | | | | | | | | | | |
| Use Category | | | Costs | | | Benefits | | | | | | Net Benefits | | | |
| Option 1  (Final Rule) | | Option 2  (Alternative) | Option 1  (Final Rule) | | | Option 2  (Alternative) | | | Option 1  (Final Rule) | | Option 2  (Alternative) | |
| Manufacturing | | | $208,710 | | $208,710 | $12 | | | $12 | | | ($208,698) | | ($208,698) | |
| Import/Repackage | | | $851,208 | | $851,208 | $1,154 | | | $1,154 | | | ($850,054) | | ($850,054) | |
| Processing as a reactant | | | $646,156 | | $646,156 | $1,672 | | | $1,672 | | | ($644,484) | | ($644,484) | |
| Waste Handling, Disposal, Treatment, and Recycling | | | $8,811,805 | | $8,811,805 | $11,851 | | | $11,851 | | | ($8,799,954) | | ($8,799,954) | |
| Laboratory Use | | | $281,701 | | $281,701 | $262 | | | $262 | | | ($281,439) | | ($281,439) | |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | | | $865,821 | | $166,273,554 | $21,490 | | | $21,519 | | | ($844,331) | | ($166,252,035) | |
| Aerospace Paint and Coating Removers | | | $2,169,416 | | $2,169,416 | $29,568 | | | $29,585 | | | ($2,139,847) | | ($2,139,830) | |
| Cellulose Triacetate Film Production | | | $12,485 | | $12,485 | $306 | | | $305 | | | ($12,179) | | ($12,180) | |
| Furniture Refinishing | | | $16,492,766 | | $16,492,766 | $142,063 | | | $140,920 | | | ($16,350,703) | | ($16,351,846) | |
| Glues, Sealants, Adhesives, and Caulks | | | $266,093 | | $347,570 | $193,663 | | | $452,693 | | | ($72,429) | | $105,123 | |
| Vapor Degreasing | | | $4,223,532 | | $4,223,532 | $1,472 | | | $1,472 | | | ($4,222,060) | | ($4,222,060) | |
| Liquid Cleaners and Degreasers | | | $56,393 | | $56,393 | $215,536 | | | $215,536 | | | $159,142 | | $159,142 | |
| Aerosol Spray Cleaning/Degreasing | | | $1,061,122 | | $1,061,122 | $1,186,124 | | | $1,186,124 | | | $125,001 | | $125,001 | |
| Paint and Coating Removers (graffiti Removal) | | | $837 | | $837 | $17,000 | | | $17,000 | | | $16,163 | | $16,163 | |
| Paint and Coating Removers (Bathtub Refinishing) | | | $3,475 | | $3,475 | $5,224,690 | | | $5,224,690 | | | $5,221,215 | | $5,221,215 | |
| Paint and Coating Removers (Automotive Repair and Refinishing) | | | $49,205 | | $49,205 | $65,554 | | | $65,554 | | | $16,349 | | $16,349 | |
| Paint and Coating Removers (Art Restoration) | | | $317 | | $317 | $3 | | | $3 | | | ($314) | | ($314) | |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | | | $10,605 | | $10,605 | $17,958 | | | $17,958 | | | $7,353 | | $7,353 | |
| Paint and Coating Removers (Professional Contracting) | | | $4,958 | | $4,958 | $11,069,134 | | | $11,069,134 | | | $11,064,176 | | $11,064,176 | |
| Adhesive and Caulk Remover | | | $32,778 | | $32,778 | $4,729,364 | | | $4,729,364 | | | $4,696,586 | | $4,696,586 | |
| Lithographic Printing Cleaner | | | $19,307 | | $19,307 | $6,631 | | | $6,631 | | | ($12,675) | | ($12,675) | |
| Dry Cleaning and Spot Removers | | | $12,882 | | $12,882 | $50,001 | | | $50,001 | | | $37,119 | | $37,119 | |
| Paint and Coatings | | | $553,868 | | $553,868 | $7,022 | | | $7,022 | | | ($546,846) | | ($546,846) | |
| Lubricants and Greases | | | $143,039 | | $143,039 | $869,032 | | | $869,032 | | | $725,993 | | $725,993 | |
| Cold Pipe Insulation | | | $64,878 | | $64,878 | $716,766 | | | $716,766 | | | $651,888 | | $651,888 | |
| Anti-spatter Welding Aerosol | | | $103,209 | | $103,209 | $210,664 | | | $210,664 | | | $107,454 | | $107,454 | |
| **Total** | | | **$36,946,566** | | **$202,435,776** | **$24,788,990** | | | **$25,046,923** | | | **($12,157,576)** | | **($177,388,853)** | |
| Note: Costs and benefits for processors reformulating their methylene chloride products are accounted for under the use categories of the products being reformulated. | | | | | | | | | | | | | | | |
| Table 9‑3: Total 20-Year Annualized Net Benefits by Use Category and Option (High Benefits Estimate, 3 Percent Discount Rate, 2022$) | | | | | | | | | | | | | | | |
| Use Category | | | Costs | | | Benefits | | | | | Net Benefits | | | | |
| Option 1  (Final Rule) | | Option 2  (Alternative) | Option 1  (Final Rule) | | Option 2  (Alternative) | | | Option 1  (Final Rule) | | | Option 2  (Alternative) | |
| Manufacturing | | | $208,710 | | $208,710 | $12 | | $12 | | | ($208,698) | | | ($208,698) | |
| Import/Repackage | | | $851,208 | | $851,208 | $1,167 | | $1,167 | | | ($850,041) | | | ($850,041) | |
| Processing as a reactant | | | $646,156 | | $646,156 | $1,691 | | $1,691 | | | ($644,466) | | | ($644,466) | |
| Waste Handling, Disposal, Treatment, and Recycling | | | $8,811,805 | | $8,811,805 | $11,982 | | $11,982 | | | ($8,799,823) | | | ($8,799,823) | |
| Laboratory Use | | | $281,701 | | $281,701 | $264 | | $264 | | | ($281,436) | | | ($281,436) | |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | | | $865,821 | | $166,273,554 | $21,758 | | $21,728 | | | ($844,063) | | | ($166,251,825) | |
| Aerospace Paint and Coating Removers | | | $2,169,416 | | $2,169,416 | $29,914 | | $29,897 | | | ($2,139,502) | | | ($2,139,519) | |
| Cellulose Triacetate Film Production | | | $12,485 | | $12,485 | $309 | | $309 | | | ($12,176) | | | ($12,176) | |
| Furniture Refinishing | | | $16,492,766 | | $16,492,766 | $142,462 | | $143,617 | | | ($16,350,304) | | | ($16,349,149) | |
| Glues, Sealants, Adhesives, and Caulks | | | $266,093 | | $347,570 | $457,717 | | $195,813 | | | $191,625 | | | ($151,757) | |
| Vapor Degreasing | | | $4,223,532 | | $4,223,532 | $1,487 | | $1,487 | | | ($4,222,044) | | | ($4,222,044) | |
| Liquid Cleaners and Degreasers | | | $56,393 | | $56,393 | $217,862 | | $217,862 | | | $161,469 | | | $161,469 | |
| Aerosol Spray Cleaning/Degreasing | | | $1,061,122 | | $1,061,122 | $1,198,926 | | $1,198,926 | | | $137,804 | | | $137,804 | |
| Paint and Coating Removers (graffiti Removal) | | | $837 | | $837 | $17,183 | | $17,183 | | | $16,346 | | | $16,346 | |
| Paint and Coating Removers (Bathtub Refinishing) | | | $3,475 | | $3,475 | $5,224,945 | | $5,224,945 | | | $5,221,470 | | | $5,221,470 | |
| Paint and Coating Removers (Automotive Repair and Refinishing) | | | $49,205 | | $49,205 | $66,271 | | $66,271 | | | $17,066 | | | $17,066 | |
| Paint and Coating Removers (Art Restoration) | | | $317 | | $317 | $3 | | $3 | | | ($314) | | | ($314) | |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | | | $10,605 | | $10,605 | $18,157 | | $18,157 | | | $7,552 | | | $7,552 | |
| Paint and Coating Removers (Professional Contracting) | | | $4,958 | | $4,958 | $11,069,675 | | $11,069,675 | | | $11,064,718 | | | $11,064,718 | |
| Adhesive and Caulk Remover | | | $32,778 | | $32,778 | $4,781,856 | | $4,781,856 | | | $4,749,077 | | | $4,749,077 | |
| Lithographic Printing Cleaner | | | $19,307 | | $19,307 | $6,705 | | $6,705 | | | ($12,602) | | | ($12,602) | |
| Dry Cleaning and Spot Removers | | | $12,882 | | $12,882 | $50,556 | | $50,556 | | | $37,674 | | | $37,674 | |
| Paint and Coatings | | | $553,868 | | $553,868 | $7,100 | | $7,100 | | | ($546,768) | | | ($546,768) | |
| Lubricants and Greases | | | $143,039 | | $143,039 | $878,677 | | $878,677 | | | $735,638 | | | $735,638 | |
| Cold Pipe Insulation | | | $64,878 | | $64,878 | $724,722 | | $724,722 | | | $659,844 | | | $659,844 | |
| Anti-spatter Welding Aerosol | | | $103,209 | | $103,209 | $213,002 | | $213,002 | | | $109,792 | | | $109,792 | |
| **Total** | | | **$36,946,566** | | **$202,435,776** | **$25,144,404** | | **$24,883,608** | | | **($11,802,162)** | | | **($177,552,167)** | |
| Note: Costs and benefits for processors reformulating their methylene chloride products are accounted for under the use categories of the products being reformulated. | | | | | | | | | | | | | | | |
| Table 9‑4: Total 20-Year Annualized Net Benefits by Use Category and Option (Low Benefits Estimate, 7 Percent Discount Rate, 2022$) | | | | | | | | | | | | | | | |
| Use Category | | | Costs | | | Benefits | | | | | Net Benefits | | | | |
| Option 1  (Final Rule) | | Option 2  (Alternative) | Option 1  (Final Rule) | | Option 2  (Alternative) | | | Option 1  (Final Rule) | | | Option 2  (Alternative) | |
| Manufacturing | | | $207,431 | | $207,431 | $6 | | $6 | | | ($207,425) | | | ($207,425) | |
| Import/Repackage | | | $843,084 | | $843,084 | $543 | | $543 | | | ($842,542) | | | ($842,542) | |
| Processing as a reactant | | | $640,793 | | $640,793 | $786 | | $786 | | | ($640,007) | | | ($640,007) | |
| Waste Handling, Disposal, Treatment, and Recycling | | | $8,753,047 | | $8,753,047 | $5,574 | | $5,574 | | | ($8,747,473) | | | ($8,747,473) | |
| Laboratory Use | | | $279,477 | | $279,477 | $123 | | $123 | | | ($279,354) | | | ($279,354) | |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | | | $858,085 | | $227,704,065 | $10,108 | | $10,121 | | | ($847,977) | | | ($227,693,943) | |
| Aerospace Paint and Coating Removers | | | $2,149,325 | | $2,149,325 | $13,908 | | $13,914 | | | ($2,135,417) | | | ($2,135,411) | |
| Cellulose Triacetate Film Production | | | $12,368 | | $12,368 | $144 | | $144 | | | ($12,224) | | | ($12,224) | |
| Furniture Refinishing | | | $16,664,027 | | $16,664,027 | $66,765 | | $66,449 | | | ($16,597,262) | | | ($16,597,578) | |
| Glues, Sealants, Adhesives, and Caulks | | | $250,560 | | $464,928 | $72,048 | | $212,925 | | | ($178,512) | | | ($252,003) | |
| Vapor Degreasing | | | $5,966,075 | | $5,966,075 | $694 | | $694 | | | ($5,965,381) | | | ($5,965,381) | |
| Liquid Cleaners and Degreasers | | | $76,768 | | $76,768 | $100,130 | | $100,130 | | | $23,362 | | | $23,362 | |
| Aerosol Spray Cleaning/Degreasing | | | $1,451,930 | | $1,451,930 | $551,027 | | $551,027 | | | ($900,903) | | | ($900,903) | |
| Paint and Coating Removers (graffiti Removal) | | | $1,138 | | $1,138 | $7,897 | | $7,897 | | | $6,760 | | | $6,760 | |
| Paint and Coating Removers (Bathtub Refinishing) | | | $4,724 | | $4,724 | $5,080,546 | | $5,080,546 | | | $5,075,822 | | | $5,075,822 | |
| Paint and Coating Removers (Automotive Repair and Refinishing) | | | $66,917 | | $66,917 | $30,859 | | $30,859 | | | ($36,057) | | | ($36,057) | |
| Paint and Coating Removers (Art Restoration) | | | $432 | | $432 | $2 | | $2 | | | ($430) | | | ($430) | |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | | | $14,421 | | $14,421 | $8,446 | | $8,446 | | | ($5,975) | | | ($5,975) | |
| Paint and Coating Removers (Professional Contracting) | | | $6,740 | | $6,740 | $10,763,749 | | $10,763,749 | | | $10,757,010 | | | $10,757,010 | |
| Adhesive and Caulk Remover | | | $44,581 | | $44,581 | $2,224,463 | | $2,224,463 | | | $2,179,882 | | | $2,179,882 | |
| Lithographic Printing Cleaner | | | $25,826 | | $25,826 | $3,119 | | $3,119 | | | ($22,707) | | | ($22,707) | |
| Dry Cleaning and Spot Removers | | | $17,488 | | $17,488 | $23,518 | | $23,518 | | | $6,030 | | | $6,030 | |
| Paint and Coatings | | | $739,614 | | $739,614 | $3,303 | | $3,303 | | | ($736,311) | | | ($736,311) | |
| Lubricants and Greases | | | $194,965 | | $194,965 | $408,750 | | $408,750 | | | $213,786 | | | $213,786 | |
| Cold Pipe Insulation | | | $88,694 | | $88,694 | $337,132 | | $337,132 | | | $248,438 | | | $248,438 | |
| Anti-spatter Welding Aerosol | | | $139,038 | | $139,038 | $99,086 | | $99,086 | | | ($39,952) | | | ($39,952) | |
| **Total** | | | **$39,497,548** | | **$266,557,895** | **$19,812,726** | | **$19,953,307** | | | **($19,684,821)** | | | **($246,604,588)** | |
| Note: Costs and benefits for processors reformulating their methylene chloride products are accounted for under the use categories of the products being reformulated. | | | | | | | | | | | | | | | |
| Table 9‑5: Total 20-Year Annualized Net Benefits by Use Category and Option (High Benefits Estimate, 7 Percent Discount Rate, 2022$) | | | | | | | | | | | | | | | |
| Use Category | | | Costs | | | Benefits | | | | | Net Benefits | | | | |
| Option 1  (Final Rule) | | Option 2  (Alternative) | Option 1  (Final Rule) | | Option 2  (Alternative) | | | Option 1  (Final Rule) | | | Option 2  (Alternative) | |
| Manufacturing | | | $207,431 | | $207,431 | $6 | | $6 | | | ($207,425) | | | ($207,425) | |
| Import/Repackage | | | $843,084 | | $843,084 | $550 | | $550 | | | ($842,535) | | | ($842,535) | |
| Processing as a reactant | | | $640,793 | | $640,793 | $796 | | $796 | | | ($639,997) | | | ($639,997) | |
| Waste Handling, Disposal, Treatment, and Recycling | | | $8,753,047 | | $8,753,047 | $5,645 | | $5,645 | | | ($8,747,402) | | | ($8,747,402) | |
| Laboratory Use | | | $279,477 | | $279,477 | $125 | | $125 | | | ($279,352) | | | ($279,352) | |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | | | $858,085 | | $227,704,065 | $10,251 | | $10,237 | | | ($847,834) | | | ($227,693,828) | |
| Aerospace Paint and Coating Removers | | | $2,149,325 | | $2,149,325 | $14,092 | | $14,085 | | | ($2,135,233) | | | ($2,135,239) | |
| Cellulose Triacetate Film Production | | | $12,368 | | $12,368 | $145 | | $146 | | | ($12,222) | | | ($12,222) | |
| Furniture Refinishing | | | $16,664,027 | | $16,664,027 | $67,260 | | $67,580 | | | ($16,596,767) | | | ($16,596,447) | |
| Glues, Sealants, Adhesives, and Caulks | | | $250,560 | | $464,928 | $215,647 | | $72,969 | | | ($34,913) | | | ($391,959) | |
| Vapor Degreasing | | | $5,966,075 | | $5,966,075 | $703 | | $703 | | | ($5,965,373) | | | ($5,965,373) | |
| Liquid Cleaners and Degreasers | | | $76,768 | | $76,768 | $101,351 | | $101,351 | | | $24,584 | | | $24,584 | |
| Aerosol Spray Cleaning/Degreasing | | | $1,451,930 | | $1,451,930 | $557,750 | | $557,750 | | | ($894,181) | | | ($894,181) | |
| Paint and Coating Removers (graffiti Removal) | | | $1,138 | | $1,138 | $7,994 | | $7,994 | | | $6,856 | | | $6,856 | |
| Paint and Coating Removers (Bathtub Refinishing) | | | $4,724 | | $4,724 | $5,080,680 | | $5,080,680 | | | $5,075,956 | | | $5,075,956 | |
| Paint and Coating Removers (Automotive Repair and Refinishing) | | | $66,917 | | $66,917 | $31,236 | | $31,236 | | | ($35,681) | | | ($35,681) | |
| Paint and Coating Removers (Art Restoration) | | | $432 | | $432 | $2 | | $2 | | | ($430) | | | ($430) | |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | | | $14,421 | | $14,421 | $8,554 | | $8,554 | | | ($5,867) | | | ($5,867) | |
| Paint and Coating Removers (Professional Contracting) | | | $6,740 | | $6,740 | $10,764,034 | | $10,764,034 | | | $10,757,294 | | | $10,757,294 | |
| Adhesive and Caulk Remover | | | $44,581 | | $44,581 | $2,252,901 | | $2,252,901 | | | $2,208,320 | | | $2,208,320 | |
| Lithographic Printing Cleaner | | | $25,826 | | $25,826 | $3,159 | | $3,159 | | | ($22,667) | | | ($22,667) | |
| Dry Cleaning and Spot Removers | | | $17,488 | | $17,488 | $23,819 | | $23,819 | | | $6,331 | | | $6,331 | |
| Paint and Coatings | | | $739,614 | | $739,614 | $3,345 | | $3,345 | | | ($736,269) | | | ($736,269) | |
| Lubricants and Greases | | | $194,965 | | $194,965 | $413,976 | | $413,976 | | | $219,011 | | | $219,011 | |
| Cold Pipe Insulation | | | $88,694 | | $88,694 | $341,442 | | $341,442 | | | $252,748 | | | $252,748 | |
| Anti-spatter Welding Aerosol | | | $139,038 | | $139,038 | $100,353 | | $100,353 | | | ($38,685) | | | ($38,685) | |
| **Total** | | | **$39,497,548** | | **$266,557,895** | **$20,005,814** | | **$19,863,436** | | | **($19,491,734)** | | | **($246,694,460)** | |
| Note: Costs and benefits for processors reformulating their methylene chloride products are accounted for under the use categories of the products being reformulated. | | | | | | | | | | | | | | | |
| Table 9‑6: Total 20-Year Annualized Net Benefits by Option, (Millions, 2022$) | | | | | | | | | | | | | | |
| Estimate | Costs | | | Benefits | | | | | | Net Benefits | | | | |
| Option 1  (Final Rule) | Option 2  (Alternative) | | Option 1  (Final Rule) | | | Option 2  (Alternative) | | | Option 1  (Final Rule) | | | Option 2  (Alternative) | |
| Low Benefits, 3 Percent Discount Rate | $37 | $202 | | $25 | | | $25 | | | ($12) | | | ($177) | |
| High Benefits, 3 Percent Discount Rate | $37 | $202 | | $25 | | | $25 | | | ($12) | | | ($178) | |
| Low Benefits, 7 Percent Discount Rate | $39 | $267 | | $20 | | | $20 | | | ($20) | | | ($247) | |
| High Benefits, 7 Percent Discount Rate | $39 | $267 | | $20 | | | $20 | | | ($19) | | | ($247) | |

# Economic Impact Analyses

In addition to the cost analysis presented in Chapter 7, several other types of impacts are important to consider in evaluating the effects of a regulation. This chapter presents the incremental impact of the final rule on:

* The environmental health risk or safety risk to children due to the regulation, as required by Executive Order 13045–Protection of Children from Environmental Health & Safety Risks (Section 10.1);
* Small Entities, as required by the Regulatory Flexibility Act (RFA) of 1980, amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996 (Section 10.2);
* Employment Impact Analysis (Section 0);
* Paperwork burden, as required by the Paperwork Reduction Act (Section 10.4);
* State and Local Governments, as required by the Unfunded Mandates Reform Act (Section 10.5);
* Environmental Justice, as required by Executive Order 12898–Environmental Justice (Section 10.6);
* Impacts on Technological Innovation and the National Economy (Section 10.7);
* Federalism, as required by Executive Order 13132 (Section 10.8); and
* Tribal governments, as required by Executive Order 13175 (Section 10.9).

## Protection of Children from Environmental Health Risks and Safety Risks

Executive Order 13045 (62 FR 19885, April 23, 1997) directs federal agencies to include an evaluation of the health and safety effects of the planned regulation on children in federal health and safety standards and explain why the regulation is preferable to potentially effective and reasonably feasible alternatives. This action is not subject to Executive Order 13045 because EPA does not believe the environmental health or safety risks addressed by this action present a disproportionate risk to children as reflected by the conclusions of the methylene chloride risk evaluation ([EPA 2020i](#_ENREF_104)). EPA did not find that the adverse health impacts for children and for men and women of reproductive age was disproportionate in comparison to other populations. While there is some evidence of an association between methylene chloride and developmental neurological effects, the literature contains methodological limitations in human studies and concentration limitations in animal studies, and thus reproductive/development effects were not carried forward to dose-response. However, EPA’s Policy on Children’s Health applies to this action.

## Small Entity Impacts

This section addresses the potential impacts of the final rule on small entities. EPA has also prepared a document, Final Regulatory Flexibility Analysis for Methylene Chloride; Regulation of Methylene Chloride under TSCA §6(a) Final Rule; RIN 2070-AK70, that includes additional discussion of how EPA considered the rule’s impacts on small entities. Figure 10‑1 provides an overview of the approach used for the small business analysis. As indicated in the figure, two different approaches are used depending on whether specific individual entities affected are known. When some of the specific affected entities are known, NAICS, employment, and revenue data are retrieved from the [Experian (2023)](#_ENREF_19) or the Dun and Bradstreet Hoovers database ([Dun & Bradstreet 2022](#_ENREF_17))[[20]](#footnote-22), and these data are used to make the small business determinations and for comparing costs to revenues. When the specific entities affected are not known, [U.S. Census Bureau (2021)](#_ENREF_79) county business patterns data by enterprise receipt size is used to estimate the percentage of affected entities that are small and the distribution of revenues for small businesses that are used for the comparison of costs and revenues. The cost to revenue impact ratios are calculated using 7% annualized cost estimates derived in Chapter 7.

Small entity impacts are estimated by use category, for the following use categories:

* Use categories where specific entities affected are known:
  + Manufacturing
  + Import/Repackage
  + Processing as a Reactant
  + Incorporation Into Formulation, Mixture, or Reaction Product
  + Processing Aid, Plastics Manufacturing, and Solvent Welding
  + Cellulose Triacetate Film Production
  + Vapor Degreasing
* Use categories where specific entities affected are not known:
  + Waste Handling, Disposal, Treatment, and Recycling
  + Laboratory Use
  + Aerospace Paint and Coating Removers
  + Furniture Refinishing
  + Glues, Sealants, Adhesives, and Caulks
  + Liquid Cleaners and Degreasers
  + Aerosol Spray Cleaning/Degreasing
  + Paint and Coating Removers (graffiti Removal)
  + Paint and Coating Removers (Bathtub Refinishing)
  + Paint and Coating Removers (Automotive Repair and Refinishing)
  + Paint and Coating Removers (Art Restoration)
  + Paint and Coating Removers (Pleasure Craft Building and Repairing)
  + Paint and Coating Removers (Professional Contracting)
  + Adhesive and Caulk Remover
  + Lithographic Printing Cleaner
  + Dry Cleaning and Spot Removers
  + Paint and Coatings
  + Lubricants and Greases
  + Cold Pipe Insulation
  + Anti-spatter Welding Aerosol

There are no methylene chloride manufacturers or entities using methylene chloride in cellulose triacetate film production that are small entities according to SBA’s small business thresholds ([SBA 2023](#_ENREF_111)).

Except for vapor degreasing, no cost impacts beyond rule familiarization costs are estimated for users of products that contain methylene chloride who will need to switch to alternative products that do not contain methylene chloride (*e.g.*, methylene chloride aerosol spray cleaners and degreasers). As noted in Chapter 3, alternative products with similar costs and efficacy are generally available. Alternative products that are drop-in substitutes (i.e., requiring no changes by the user in how the product is used) were generally available. However, in some cases some effort might be required by firms using methylene chloride products to identify suitable alternatives, test them for their desired applications, learn how to use them safely and effectively, and implement new processes for using the alternative products. The information to estimate how often these costs might be incurred or what the specific costs would be per-user or per-firm when they are incurred is not available. Therefore, EPA is unable to consider these costs quantitatively in the FRFA or Economic Analysis.

As noted in section 7.12, paint and coating removers are one product type where methylene chloride is likely the most effective product for many applications. In particular, alternatives to methylene chloride paint and coating removers in furniture refinishing may not be effective enough for this use. The impact of a prohibition of methylene chloride for furniture refinishing could result in the closure of an unknown number of affected entities.

Section 10.2.1 discusses the regulatory requirements for this analysis. Section 10.2.2 presents the estimated numbers of affected small entities. Section 10.2.3 presents the estimated cost impacts of the rule on the affected small entities. Section 10.2.4 presents a summary of the small entity impacts.

|  |
| --- |
| Figure 10‑1: Overview of small business analysis approach, which differs depending on whether the specific entities affected are known |
|  |

### Regulatory Requirement for Small Business Analysis

The Regulatory Flexibility Act (RFA) of 1980, amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996, requires regulators to assess the effects of regulations on small entities including businesses, nonprofit organizations, and governments. In some instances, agencies are also required to examine regulatory alternatives that may reduce adverse economic effects on significantly impacted small entities. The RFA requires agencies to prepare an initial and final regulatory flexibility analysis for each rule unless the Agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. The RFA, however, does not specifically define “a significant economic impact on a substantial number” of small entities. Sections 603 and 604 of the RFA require that regulatory flexibility analyses identify the types and numbers of small entities to which the rule would apply, describe the rule requirements to which small entities would be subject, and describe any regulatory alternatives, including exemptions and deferral, which would lessen the rule’s burden on small entities. Under the Regulatory Flexibility Act (RFA), the definition of a “small business” is determined by the U.S. Small Business Administration’s regulations at 13 CFR 121.201 (which create small business size standards using either a sales or employment threshold, depending on the nature of the industry), unless an agency establishes an alternate definition.

To fulfill the requirements of the RFA, this analysis addresses two basic questions regarding the rule: (1) the number and type of small entities potentially affected, and (2) the extent of the rule’s potential economic impact on those entities as measured by the cost-to-revenue ratio. This ratio is a good measure of entities’ ability to afford the costs attributable to a regulatory requirement because comparing compliance costs to revenues or expenses provides a reasonable indication of the magnitude of the regulatory burden relative to a commonly available measure of economic activity. Where regulatory costs represent a small fraction of a typical entity’s revenues or expenses, the financial impacts of the regulation on such entities may be considered as not significant.

### Estimated Number of Affected Small Entities

As noted above, the number of small entities with cost impacts is estimated using either [Experian (2023)](#_ENREF_19) or [U.S. Census Bureau (2021)](#_ENREF_79) data, depending on whether the individual affected entities are known.[[21]](#footnote-23)

#### Use Categories with Some Known Individual Affected Entities

Table 10‑1 presents the estimated total number of affected entities and the estimated number of affected entities defined as small businesses for the use categories where [Experian (2023)](#_ENREF_19) data for known affected entities were used to make the small business determinations.[[22]](#footnote-24) For some use categories, sufficient data on most of the individual affected firms were available to make a small business determinations. For other use categories, available data were more limited. For example, for the Processing as a Reactant Use Category, only the individual firms that also import methylene chloride for this purpose could be identified using EPA’s ([EPA 2022a](#_ENREF_107)) CDR data. The number of affected small entities was estimated based on the percentage of entities in the that were small among the firms in the Processing Aid, Plastics Manufacturing, and Solvent Welding use category.

| Table 10‑1: Number of Affected Small Entities for Use Categories Estimated from Individual Affected Entities | | | |
| --- | --- | --- | --- |
| Use Category | Small Entity NAICS | Affected Entities (Including firms that are not small) | Estimated Number of Affected Small Entities |
| Manufacturing | 424690, 325199 | 6 | 2 |
| Import/Repackage | 339999, 424690 | 26 | 4 |
| Processing as a Reactant1 | 325199, 325211 | 35 | 5 |
| Incorporation Into Formulation, Mixture, or Reaction Product | 332812, 424690, 325180, 325998, 333415, 325611, 333992, 423830, 423840, 423850, 339999, 325520, 332322, 339940, 423840424910, 325510, 325612, 561910 | 54 | 37 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | 325180, 325998 | 44 | 7 |
| Aerospace Paint and Coating Removers | 238320, 488190 | 272 | 270 |
| Cellulose Triacetate Film Production | - | 1 | 0 |
| Vapor Degreasing | 333310, 336413, 332999, 332721, 336370, 332119, 332813, 424690, 326199 | 17 | 10 |
| 1The percentage of small entities for the Processing as a Reactant use category is assumed to be the same as estimated for the Processing Aid, Plastics Manufacturing, and Solvent Welding use categories.  Source: [Experian (2023)](#_ENREF_19) | | | |

#### Use Categories without Known Individual Affected Entities

[U.S. Census Bureau (2021)](#_ENREF_79) county business patterns data by enterprise receipt size is used to estimate the number of small entities in the use categories without known individual affected entities. Since the [U.S. Census Bureau (2021)](#_ENREF_79) reflects 2017 receipts, they were inflated to 2022$ using the GDP deflator ([BEA 2023](#_ENREF_71)). See Table 3‑1, above, for the numbers of firms above and below SBA’s small business revenue thresholds ([SBA 2023](#_ENREF_111)) for the NAICS in these use categories.

The percentage of firms that are small entities shown in Table 10‑2 is calculated from the share of firms in each affected NAICS that are defined as small (see the total number of firms and the number of small firms by NAICS in Table 3‑1). Number of affected small firms is calculated by multiplying the total number of affected firms by the percentage that are small.

| Table 10‑2: Number of Affected Firms and Small Firms Estimated from Census Data | | | | |
| --- | --- | --- | --- | --- |
| Use Category | Small Entity NAICS | Number of Affected Firms | Percent Small | Number of Affected Small Firms |
| Waste Handling, Disposal, Treatment, and Recycling | 562211, 562213, 562920 | 1,091 | 88% | 963 |
| Laboratory Use | 541380, 621511 | 56 | 93% | 52 |
| Aerospace Paint and Coating Removers | 238320, 488190 | 272 | 99% | 270 |
| Furniture Refinishing | 236118, 236220, 238130, 238320, 238330, 238350, 238990, 321918, 321999, 337110, 337121, 337122, 337127, 337214, 423210, 423420, 423990, 442110, 442299, 451130, 451140, 453310, 484210, 541410, 541611, 561720, 561740, 561990, 711510, 811121, 811310, 811412, 811420, 811430, 811490 | 4,899 | 99% | 4,829 |
| Glues, Sealants, Adhesives, and Caulks | 322130, 322211, 325998, 326121, 326160, 326211, 332215, 332322, 332813, 332999, 334310, 335911, 336411, 336612, 337110, 337121, 337211, 339920, 339950, 339992, 481111, 485111, 811420 | 3,986 | 98% | 3,913 |
| Vapor Degreasing | 333310, 336413, 332999, 332721, 336370, 332119, 332813, 424690, 326199 | 17 | 59% | 10 |
| Liquid Cleaners and Degreasers | 311812, 312230, 314999, 321113, 322121, 325220, 325992, 325998, 326121, 326191, 326199, 326299, 327331, 331210, 331410, 331420, 331512, 332111, 332112, 332117, 332119, 332215, 332216, 332311, 332313, 332410, 332420, 332431, 332439, 332510, 332618, 332721, 332722, 332811, 332812, 332813, 332912, 332913, 332919, 332994, 332996, 332999, 333120, 333132, 333249, 333318, 333413, 333415, 333511, 333611, 333994, 333999, 334310, 334412, 334413, 334416, 334417, 334419, 334510, 334511, 334512, 334513, 334515, 334519, 335121, 335312, 335313, 335911, 335921, 335929, 335999, 336111, 336211, 336310, 336340, 336411, 336413, 336510, 336612, 337122, 337125, 337127, 339112, 339113, 339114, 339910, 339920, 339992, 339995, 339999, 493110, 541714, 541715, 811121, 811310 | 7,190 | 95% | 6,836 |
| Aerosol Spray Cleaning/Degreasing | 326211, 326212, 441110, 441120, 443141, 447110, 447190, 451110, 481111, 481112, 481211, 481212, 481219, 483111, 483112, 483113, 483114, 483211, 483212, 484110, 484121, 484122, 484210, 484220, 484230, 485111, 485113, 485119, 485210, 485310, 485410, 485510, 485991, 485999, 486110, 486210, 486910, 487110, 487210, 487990, 488119, 488190, 488210, 488310, 488320, 488330, 488390, 488410, 488490, 488510, 488991, 488999, 811111, 811112, 811113, 811118, 811121, 811122, 811191, 811198, 811211, 811212, 811213, 811219, 811310, 811411, 811490 | 170,063 | 98% | 166,254 |
| Paint and Coating Removers (graffiti Removal) | 5612 | 105 | 84% | 88 |
| Paint and Coating Removers (Bathtub Refinishing) | 236118, 238340, 238390, 238990, 442210, 444190, 561990, 811411, 811412, 811420 | 436 | 99% | 430 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | 339950, 423120, 441110, 441120, 441310, 488410, 811111, 811118, 811121, 811122, 811198, 811412 | 5,891 | 98% | 5,785 |
| Paint and Coating Removers (Art Restoration) | 339999, 453310, 453920, 453998, 711510, 712110, 811420, 811490, 812921 | 38 | 97% | 37 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | 336611, 336612, 423910, 441222, 811310 | 1,279 | 96% | 1,234 |
| Paint and Coating Removers (Professional Contracting) | 236115, 236116, 236118, 236210, 236220, 237310, 238110, 238130, 238140, 238160, 238220, 238310, 238320, 238330, 238350, 238990, 325612, 333912, 424690, 444120, 541410, 561720, 561730, 561740, 561790, 561990, 812990 | 622 | 99% | 613 |
| Adhesive and Caulk Remover | 322130, 322211, 325998, 326121, 326160, 326211, 332215, 332322, 332813, 332999, 334310, 335911, 336411, 336612, 337110, 337121, 337211, 339920, 339950, 339992, 481111, 485111, 811420 | 3,986 | 98% | 3,913 |
| Lithographic Printing Cleaner | 323111, 333244, 511110, 611310 | 221 | 78% | 172 |
| Dry Cleaning and Spot Removers | 812310, 812320 | 1,391 | 99% | 1,383 |
| Paint and Coatings | 321991, 321992, 322220, 323113, 325199, 325510, 325520, 325991, 325992, 325998, 326130, 326199, 326211, 326220, 326299, 331110, 331210, 332313, 332322, 332812, 332813, 332993, 332994, 332999, 333131, 333132, 333413, 333922, 333994, 333996, 334220, 335312, 336211, 336212, 336213, 336214, 336390, 337121, 337122, 337211, 337215, 339950, 339991, 339993, 424690, 441110, 441222, 481111, 488119, 488190, 541714, 611310, 811111, 811121, 811310 | 123 | 97% | 119 |
| Lubricants and Greases | 324191, 339920, 451110, 811111, 811112, 811113, 811118, 811121, 811122, 811191, 811198, 811211, 811212, 811213, 811219, 811310, 811411, 811490 | 19,450 | 99% | 19,170 |
| Cold Pipe Insulation | 238220, 238290 | 10,695 | 98% | 10,471 |
| Anti-spatter Welding Aerosol | 811113, 811118, 811121, 811310 | 5,992 | 98% | 5,854 |

### Estimated Costs and Small Business Impacts

Table 10‑3 presents the estimated average costs per entity and the range for estimated small business revenues.

Costs for manufacturers and importers reflect the costs of rule familiarization, downstream notification, and WCPP compliance. Costs for these affected small entities were estimated to be smaller than the average costs estimated in Chapter 7, because the small entities had fewer employees than the average number assumed to incur the per-worker WCPP costs in Chapter 7. For other use categories with WCPP costs, affected small entities had more employees that the average number of exposed workers with associated WCPP costs Chapter 7. Thus, the average WCPP costs were assumed for these affected small entities.

Costs for the incorporation into formulation, mixture, or reaction product use category reflect a reformulation cost of $5,603 per product, plus rule familiarization costs of $18 (see Table 7‑4 and Table 7‑10). In addition, paint remover formulators have an estimated WCPP compliance cost of $13,777.

End-users estimated costs are for rule familiarization (see Table 7‑4). Batch Cold Cleaning and Vapor Degreaser’s cost reflect rule familiarization (see Table 7‑4) and costs associated with switching to alternative cleaning agents and solvents (see Table 7‑40).

|  |  |  |  |
| --- | --- | --- | --- |
| Table 10‑3: Per Firm Cost Impacts for Small Businesses | | | |
| Use Category | Estimated Average per Entity Costs (2022$ 7 percent Annualized Costs) | Range for estimated small business revenues (thousands, 2022$) | Notes |
| Manufacturing | $11,878 - $19,978 | $9,045 - $9,435 | Costs of compliance with WCPP requirements. |
| Import/Repackage | $5,295 - $32,426 | $462 - $77,378 | Costs of compliance with WCPP requirements. |
| Processing as a reactant | $19,502 | $9,385 - $200,000 | Costs of compliance with WCPP requirements. |
| Incorporation Into Formulation, Mixture, or Reaction Product | $5,295 - $32,426 | $351 - $895,226 | Costs of reformulation, plus the costs of compliance with WCPP requirements for paint remover formulators. |
| Waste Handling, Disposal, Treatment, and Recycling | $8,023 | $104 - $47,000 | Costs of compliance with WCPP requirements. |
| Laboratory Use | $4,991 | $104 - $41,326 | Costs of compliance with WCPP requirements. |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | $19,502 | $9,385 - $200,000 | Costs of compliance with WCPP requirements. |
| Aerospace Paint and Coating Removers | $7,902 | $106 - $40,000 | Costs of compliance with WCPP requirements. |
| Cellulose Triacetate Film Production | - | - | No small affected entities |
| Furniture Refinishing | $3,401 | $57 - $118,074 | Costs of compliance with respirator requirements. |
| Glues, Sealants, Adhesives, and Caulks | $8 | $83 - $118,074 | Rule Familiarization Costs. |
| Vapor Degreasing | $350,946 | $1,548 - $274,862 | Costs of switching to alternative cleaning methods. |
| Liquid Cleaners and Degreasers | $8 | $83 - $118,074 | Rule Familiarization Costs. |
| Aerosol Spray Cleaning/Degreasing | $8 | $57 - $118,074 | Rule Familiarization Costs. |
| Paint and Coating Removers (graffiti Removal) | $8 | $104 - $47,000 | Rule Familiarization Costs. |
| Paint and Coating Removers (Bathtub Refinishing) | $8 | $57 - $45,000 | Rule Familiarization Costs. |
| Paint and Coating Removers (Automotive Repair and Refinishing) | $8 | $57 - $118,074 | Rule Familiarization Costs. |
| Paint and Coating Removers (Art Restoration) | $8 | $57 - $118,074 | Rule Familiarization Costs. |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | $8 | $57 - $118,074 | Rule Familiarization Costs. |
| Paint and Coating Removers (Professional Contracting) | $8 | $57 - $118,074 | Rule Familiarization Costs. |
| Adhesive and Caulk Remover | $8 | $83 - $118,074 | Rule Familiarization Costs. |
| Lithographic Printing Cleaner | $8 | $83 - $118,074 | Rule Familiarization Costs. |
| Dry Cleaning and Spot Removers | $8 | $104 - $13,000 | Rule Familiarization Costs. |
| Paint and Coatings | $8 | $57 - $118,074 | Rule Familiarization Costs. |
| Lubricants and Greases | $8 | $57 - $118,074 | Rule Familiarization Costs. |
| Cold Pipe Insulation | $8 | $106 - $22,000 | Rule Familiarization Costs. |
| Anti-spatter Welding Aerosol | $8 | $104 - $12,500 | Rule Familiarization Costs. |

### Summary of Estimated Small Business Impacts

Table 10‑4 presents a summary of the small business impacts overall and for each of the use categories where small business impacts were estimated.

| Table 10‑4: Summary of Small Business Impacts | | | | | |
| --- | --- | --- | --- | --- | --- |
| Use Category | Number of Small Firms | **Average Cost Per Small Firm** | Number and Percent of Firms by Cost-Revenue Impact Threshold | | |
| <1% | 1-3% | >3% |
| Manufacturing | 2 | $15,928 | 2 (100%) | - | - |
| Import/Repackage | 4 | $26,840 | 2 (60%) | 1 (20%) | 1 (20%) |
| Processing as a reactant | 5 | $19,502 | 5 (100%) | - | - |
| Incorporation Into Formulation, Mixture, or Reaction Product | 37 | $14,206 | 32 (87%) | 3 (8%) | 2 (5%) |
| Waste Handling, Disposal, Treatment, and Recycling | 963 | $8,023 | 591 (61%) | 229 (24%) | 143 (15%) |
| Laboratory Use | 52 | $4,991 | 31 (60%) | 12 (23%) | 9 (17%) |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | 7 | $19,502 | 7 (100%) | - | - |
| Aerospace Paint and Coating Removers | 270 | $7,902 | 61 (23%) | 83 (31%) | 126 (47%) |
| Cellulose Triacetate Film Production | - | - | - | - | - |
| Furniture Refinishing | 4,829 | $3,401 | 2,630 (54%) | 1,339 (28%) | 861 (18%) |
| Glues, Sealants, Adhesives, and Caulks | 3,913 | $8 | 3,913 (100%) | - | - |
| Vapor Degreasing | 10 | $350,946 | 3 (30%) | 1 (10%) | 6 (60%) |
| Liquid Cleaners and Degreasers | 6,836 | $8 | 6,836 (100%) | - | - |
| Aerosol Spray Cleaning/Degreasing | 166,254 | $8 | 166,254 (100%) | - | - |
| Paint and Coating Removers (graffiti Removal) | 88 | $8 | 88 (100%) | - | - |
| Paint and Coating Removers (Bathtub Refinishing) | 430 | $8 | 430 (100%) | - | - |
| Paint and Coating Removers (Automotive Repair and Refinishing) | 5,785 | $8 | 5,785 (100%) | - | - |
| Paint and Coating Removers (Art Restoration) | 37 | $8 | 37 (100%) | - | - |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | 1,234 | $8 | 1,234 (100%) | - | - |
| Paint and Coating Removers (Professional Contracting) | 613 | $8 | 613 (100%) | - | - |
| Adhesive and Caulk Remover | 3,913 | $8 | 3,913 (100%) | - | - |
| Lithographic Printing Cleaner | 172 | $8 | 172 (100%) | - | - |
| Dry Cleaning and Spot Removers | 1,383 | $8 | 1,383 (100%) | - | - |
| Paint and Coatings | 119 | $8 | 119 (100%) | - | - |
| Lubricants and Greases | 19,170 | $8 | 19,170 (100%) | - | - |
| Cold Pipe Insulation | 10,471 | $8 | 10,471 (100%) | - | - |
| Anti-spatter Welding Aerosol | 5,854 | $8 | 5,854 (100%) | - | - |
| **All Use Categories** | **232,451** | **$141** | **229,635 (99%)** | **1,668 (1%)** | **1,148 (0.5%)** |

As noted above, costs beyond rule familiarization were not estimated for other entities that use methylene chloride containing products. Chapter 5 demonstrates that alternative products with similar costs and efficacy to methylene chloride products are generally available. Alternative products that are drop-in substitutes (i.e., requiring no changes by the user in how the product is used) were generally available. However, in some cases some effort might be required by firms using methylene chloride products to identify suitable alternatives, test them for their desired applications, learn how to use them safely and effectively, and implement new processes for using the alternative products. The information to estimate how often these costs might be incurred or what the specific costs would be per-user or per-firm when they are incurred is not available. Therefore, EPA is unable to consider these costs quantitatively in the FRFA or Economic Analysis.

As noted above in section 7.13, alternatives to methylene chloride paint and coating removers in the furniture refinishing subset of the paint and coating removers use category may not be effective enough for this use to be commercially profitable. Because of these challenges, the final regulation allows methylene chloride use to continue, with WCPP requirements, for aerospace paint and coating removers from safety critical, corrosion-sensitive components of aircraft and spacecraft. For furniture refinishing, the final rule allows for 5 years of continued use of methylene chloride for refinishing of wooden pieces of artistic, cultural, or historic value, with additional worker protections during this interim period. The agency believes that this deferment of the prohibition of methylene chloride for furniture refinishing will allow the affected firms to identify technologically and economically feasible alternatives. However, furniture refinishing costs may increase if available alternatives greatly increase labor and costs of performing the work and some affected firms may ultimately discontinue this service as a result. Other firms may raise their prices for furniture refinishing as their costs increase. The direct impact on the affected firms would be the loss of producer surplus due to the increased costs for furniture refinishing. In order to quantify this cost, EPA would need to know the increase in price, the elasticity of demand, and the marginal costs. Since sufficient data are not available to develop these estimates, they are not quantified in the small business impact analysis.

It is possible to estimate that profits for the 4,899 furniture refinishing firms that use methylene chloride are approximately $63 million using the average estimated revenues per firm for NAICS 811420, Reupholstery and Furniture Repair ($338,525 is average revenue, calculated using the estimates presented in Table 3‑1) and an IRS ([2013](#_ENREF_28)) estimate for profit in this sector of 3.8% of sales. Profit is related to, but not the same as producer surplus. Producer surplus is generally larger than profit since producer surplus is the difference between total revenue and marginal cost and profit is the difference between total revenue and total cost. Total revenue for the 4,899 furniture refinishing firms that use methylene chloride is estimated to be $1.7 million. Total revenue provides a measure of overall economic activity for these firms, but does not directly relate to the potential loss of producer surplus from potential closures or price increases in the furniture refinishing industry.

EPA does not have the detailed financial data to estimate how this rule would affect the probability of increased rates of firm closure in this sector as a result of prohibiting the use of methylene chloride in paint and coating removal after 5 years. While the number of additional closures could be greater than zero, it is unlikely to approach a complete sector closure of all 4,899 firms. Table 10‑5 shows the potential lost revenue and profit in the furniture refinishing sector under varying assumptions of the number of firms which may close.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 10‑5: Estimated Revenue and Profit Losses for Furniture Refinishers by Assumed Percentage | | | |  |
| Percentage of Firms Closing | Number of Firms Closing | Revenue of Firms (2022$, Thousands) | Potential Profit Loss (2022$, Thousands) | |
| - | 1 | $339 | $13 | |
| 10 | 490 | $166,110 | $6,312 | |
| 25 | 1,225 | $415,275 | $15,780 | |
| 33 | 1,617 | $548,163 | $20,830 | |
| 50 | 2,450 | $830,550 | $31,561 | |
| 66 | 3,233 | $1,095,987 | $41,648 | |
| 75 | 3,674 | $1,245,486 | $47,328 | |
| 100 | 4,899 | $1,660,761 | $63,109 | |

## Employment Effects

This section discusses the anticipated employment impacts of this rule. To the extent possible, it describes the characteristics and labor market conditions of potentially affected workers, occupations, industries, and geographic areas. Employment impacts of environmental regulations include a mix of potential declines and gains in different sectors of the economy over time. Impacts on employment can vary according to labor market conditions and may differ across occupations, industries, and regions. Isolating employment impacts of regulation is difficult as they are a challenge to disentangle from employment impacts caused by a wide variety of ongoing concurrent economic changes. This analysis qualitatively considers the employment impacts of the rule, including on regulated sectors, sectors producing substitutes, and related sectors, upstream and downstream.

In the long run, environmental regulation is expected to cause a shift of employment among employers rather than affect the general employment level ([Arrow, Cropper et al. 1996](#_ENREF_5)). Even if they are mitigated by long-run market adjustments to full employment, many regulatory actions have transitional effects in the short run ([OMB 2015](#_ENREF_110)). These movements of workers in and out of jobs in response to environmental regulation are potentially important distributional impacts of interest to policy makers. Of particular concern are transitional job losses experienced by workers operating in declining industries, exhibiting low migration rates, or living in communities or regions where unemployment rates are high.

Compliance with environmental regulation can result in increased demand for the inputs or factors (including labor) used in the production of environmental protection. However, the regulated sector generally relies on revenues generated by their other market outputs to cover the costs of supplying increased environmental quality. This can lead to reduced demand for labor and other factors of production used to produce the market output. Employment impacts, both positive and negative, in sectors upstream and downstream from the regulated sector, or in sectors producing substitute or complimentary products, may also occur.

While EPA assumes that users of methylene chloride will switch to alternative chemicals, some facilities may choose not to do so before the effective prohibition date in the rule. As a result, the rule may result in increased likelihood of firm closures and job losses, at least temporarily, at some facilities. As noted in Chapter 7, some furniture refinishers may not be able to switch to methylene chloride free alternatives and would close as a result. However, some sectors may experience increased temporary employment associated with reformulating methylene chloride-free alternatives and converting production processes to use methylene chloride substitute technologies.

## Paperwork Burden Analysis

This section presents a summary of the burden and associated costs for the respondents associated with the recordkeeping and reporting requirements of the final action. The detailed paperwork burden analysis is presented in the information collection request (ICR) supporting statement for this rulemaking. It provides the average annual burden and cost estimates for the next three years of the program.

* 1. The paperwork burden and associated costs include the activity types listed below. Note that not all entities would incur burden or costs from these activities because they may already be meeting the requirements under as part of their usual business practices.
* Rule familiarization
  + The 6,483 facilities with PRA burdens and costs associated with a WCPP or other respiratory protection requirements are assumed to incur an initial cost of $214 for a 3-hour burden associated with rule familiarization (The corresponding annual average burden over the first three years is presented in Table 10‑5).
  + The 236,385 facilities with PRA burdens and costs associated with prohibition are assumed to incur an initial cost of $94 for a 1-hour burden associated with rule familiarization (The corresponding annual average burden over the first three years is presented in Table 10‑5).
* Downstream notification
  + Each person who processes or distributes in commerce methylene chloride or methylene chloride-containing products for any use must, prior to or concurrent with the shipment, notify companies to whom methylene chloride is shipped, in writing, of the restrictions on its use. It is assumed that 32 respondents (manufacturers, import, and repackage facilities) accomplish this by modifying the SDS to note the restrictions and the burden associated with the downstream notification requirements, including the related recordkeeping, is 2 hours, with an associated labor cost of $189 (The corresponding annual average burden over the first three years is presented in Table 10‑5).
* WCPP
  + Under the final rule, the 1,584 facilities complying with the rule through an WCPP would be required to develop exposure control plans, monitor exposure levels, maintain records of this monitoring, provide employees with information about how they can access to the exposure control plans, exposure monitoring records, PPE program implementation documentation, and respirator program documentation, and obtain an acknowledgment from the employee that they have received the information. The estimated costs and burdens are as follows:
    - The estimated burden and costs for the respiratory exposure monitoring plan and conducting exposure monitoring (generating the exposure monitoring results) are presented below in Table 10‑6 (labor costs) and Table 10‑9 (non-labor costs).
    - The estimated burden and costs for recordkeeping related to respiratory exposure monitoring are presented below in Table 10‑7.
    - The estimated burden and costs for notifications related to exposure monitoring (notifying potentially exposed workers; providing them with access to exposure control plans, exposure monitoring records, PPE program implementation documentation, and respirator program documentation; obtaining an acknowledgment that they have received this information) are presented below in Table 10‑8.
* Under the final rule, 4,899 facilities engaged in commercial use of methylene chloride in paint and coating removal for the refinishing of wooden compositions of national, cultural, or personal value using methylene chloride for refinishing furniture would have to maintain records detailing their use of methylene chloride; EPA expects these would be ordinary business records.

Table 10‑10 presents the summary of the average annual burden hours and costs per facility associated with the final rule regulatory option. See Chapter 7 for a more detailed description of how the time burden and wage rates were estimated. The burden and cost estimates provided reflect the figures provided in the accompanying Information Collection Request (ICR) for the rule.

| Table 10‑5: Paperwork Burden and Cost Associated with Rule Familiarization and Downstream Notification | | | | |
| --- | --- | --- | --- | --- |
| Activity | Number of Respondents | Average Annual Burden Per Respondent | Average Annual Total Burden | Average Annual Total Cost |
| Rule Familiarization  (WCPP and furniture refinishing firms) | 6,483 | 1 | 6,483 | $462,368 |
| Rule Familiarization (prohibition firms) | 231,486 | 0.33 | 76,390 | $7,274,820 |
| Downstream Notification (SDS) | 32 | 0.67 | 21 | $2,021 |
| A wage of $93.18 was used to calculate the labor cost (see Manufacturing/Managerial wage in Table 7‑3). | | | | |

| Table 10‑6: Paperwork Burden and Labor Cost Associated with Respiratory Monitoring | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Threshold | Number of Respondents | Number of Workers | Annual Per Respondent Burden (excludes burden estimated on a per-worker basis) | Annual Per-Worker Labor Burden | Average Annual Total Burden | Average Annual Total Cost |
| <Action Level  (1 event in first year) | 677 | 5,422 | 2.0 | 0.6 | 4,607 | $247,922 |
| Between Action Level and Limit  (2 events per year) | 148 | 1,119 | 6.0 | 3.6 | 4,917 | $261,945 |
| < 10 times the ECEL  (4 events per year) | 333 | 2,481 | 6.0 | 7.2 | 19,859 | $1,050,510 |
| < 25 times the ECEL  (4 events per year) | 58 | 412 | 6.0 | 7.2 | 3,310 | $175,147 |
| < 50 times the ECEL  (4 events per year) | 23 | 160 | 6.0 | 7.2 | 1,291 | $68,341 |
| < 1,000 times the ECEL  (4 events per year) | 346 | 1,329 | 6.0 | 7.2 | 11,643 | $620,206 |
| < 10,000 times the ECEL  (4 events per year) | - | - | 6.0 | 7.2 | - | - |
| **All Respondents** | **1,584** | **10,923** | - | - | **45,627** | **$2,424,072** |
| A blended wage for a Certified Industrial Hygienist and Technical Specialist was used to calculate the labor cost (see wage rates in Table 7‑3). The wages were weighted according to the labor mix presented in Table 7‑50. | | | | | | |

| Table 10‑7: Paperwork Burden and Labor Cost Associated with Respiratory Recordkeeping | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Threshold | Number of Respondents | Number of Workers | Annual Per Respondent Burden (excludes burden estimated on a per-worker basis) | Annual Per-Worker Labor Burden | Average Annual Total Burden | Average Annual Total Cost |
| <Action Level  (1 event in first year) | 677 | 5,422 | 2.7 | 0.06 | 2,130 | $201,796 |
| Between Action Level and Limit  (2 events per year) | 148 | 1,119 | 8.0 | 0.33 | 1,552 | $147,036 |
| < 10 times the ECEL  (4 events per year) | 333 | 2,481 | 16.0 | 0.67 | 6,986 | $661,854 |
| < 25 times the ECEL  (4 events per year) | 58 | 412 | 16.0 | 0.67 | 1,198 | $113,499 |
| < 50 times the ECEL  (4 events per year) | 23 | 160 | 16.0 | 0.67 | 475 | $45,002 |
| < 1,000 times the ECEL  (4 events per year) | 346 | 1,329 | 16.0 | 0.67 | 6,428 | $608,989 |
| < 10,000 times the ECEL  (4 events per year) | - | - | 16.0 | 0.67 | - | - |
| **All Respondents** | **1,584** | **10,923** | - | - | **18,769** | **$1,778,175** |
| A wage of $93.18 was used to calculate the labor cost (see Manufacturing/Managerial wage in Table 7‑3). | | | | | | |

| Table 10‑8: Paperwork Burden and Labor Cost Associated with Respiratory Notification | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Threshold | Number of Respondents | Number of Workers | Annual Per Respondent Burden (excludes burden estimated on a per-worker basis) | Annual Per-Worker Labor Burden | Average Annual Total Burden | Average Annual Total Cost |
| <Action Level  (1 event in first year) | 677 | 5,422 | - | 0.03 | 163 | $15,443 |
| Between Action Level and Limit  (2 events per year) | 148 | 1,119 | - | 0.17 | 190 | $18,001 |
| < 10 times the ECEL  (4 events per year) | 333 | 2,481 | - | 0.33 | 819 | $77,592 |
| < 25 times the ECEL  (4 events per year) | 58 | 412 | - | 0.33 | 136 | $12,885 |
| < 50 times the ECEL  (4 events per year) | 23 | 160 | - | 0.33 | 53 | $5,021 |
| < 1,000 times the ECEL  (4 events per year) | 346 | 1,329 | - | 0.33 | 438 | $41,496 |
| < 10,000 times the ECEL  (4 events per year) | - | - | - | 0.33 | - | - |
| **All Respondents** | **1,584** | **10,923** | - | - | **1,799** | **$170,437** |
| A wage of $93.18 was used to calculate the labor cost (see Manufacturing/Managerial wage in Table 7‑3). | | | | | | |

| Table 10‑9: Paperwork Non-Labor Cost Associated with Respiratory Monitoring | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Threshold | Number of Respondents | Average Events Per Respondent Annually | Number of Workers | Annual Per Respondent Non-Labor Costs (excludes costs estimated on a per-worker basis) | Annual Per-Worker Non-Labor Cost | Average Annual Per-Respondent Cost | Average Annual Total Cost |
| <Action Level  (1 event in first year) | 677 | 0.33 | 5,422 | $80 | $164 | $1,394 | $943,391 |
| Between Action Level and Limit  (2 events per year) | 148 | 2.00 | 1,119 | $160 | $328 | $2,643 | $390,788 |
| < 10 times the ECEL  (4 events per year) | 333 | 4.00 | 2,481 | $320 | $656 | $5,211 | $1,733,934 |
| < 25 times the ECEL  (4 events per year) | 58 | 4.00 | 412 | $320 | $656 | $5,004 | $288,490 |
| < 50 times the ECEL  (4 events per year) | 23 | 4.00 | 160 | $320 | $656 | $4,895 | $112,435 |
| < 1,000 times the ECEL  (4 events per year) | 346 | 4.00 | 1,329 | $320 | $656 | $2,839 | $982,366 |
| < 10,000 times the ECEL  (4 events per year) | - | - | - | - | - | - | - |
| **All Respondents** | **1,584** | - | **10,923** | - | - | **$2,810** | **$4,451,405** |
| See Table 7‑50. | | | | | | | |

| Table 10‑10: Summary of Three Year Average Incremental Burden Hours and Costs for Primary Option | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Activity | Number of Respondents | Average Annual Responses Per Respondent | Average Annual Burden Per Respondent | Average Annual Total Labor Burden | Average Annual Total Labor Costs | Average Annual Total Non-Labor Costs | Average Annual Total Costs |
| Agency Burden | - | - | - | - | - | - | - |
| Rule Familiarization  (WCPP and furniture refinishing firms) | 6,483 | 0.33 | 1.00 | 6,483 | $462,368 | - | $462,368 |
| Rule Familiarization (prohibition firms) | 231,486 | 0.33 | 0.33 | 76,390 | $7,274,820 | - | $7,274,820 |
| Downstream Notification (SDS) | 32 | 0.33 | 0.67 | 21 | $2,021 | - | $2,021 |
| Respiratory Monitoring | 6,483 | 2.25 | 7.04 | 45,627 | $2,424,072 | $4,451,405 | $6,875,477 |
| Respiratory Recordkeeping | 6,483 | 2.25 | 2.90 | 18,769 | $1,778,175 | - | $1,778,175 |
| Respiratory Notifications | 6,483 | 2.25 | 0.28 | 1,799 | $170,437 | - | $170,437 |
| **All Activities** | **237,969** |  | **0.63** | **149,090** | **$12,111,893** | **$4,451,405** | **$16,563,299** |

## Unfunded Mandates Reform Act (UMRA)

Title II of the Unfunded Mandates Reform Act of 1995, Pub. L. 104-4, establishes requirements for Federal agencies to assess the effects of their regulatory actions on State, local, and Tribal governments, and the private sector. Under section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with “Federal mandates” that might result in expenditures by State, local, and Tribal governments, in the aggregate, or by the private sector, of $100 million or more (when adjusted annually for inflation) in any one year. The rule is not expected to affect state, local, or Tribal governments because the rule affects entities that use methylene chloride and the use of methylene chloride by government entities is minimal. In addition, the monetized cost of the rule to the private sector does not exceed the inflation-adjusted UMRA threshold of $100 million.

## Executive Order 12898 – Environmental Justice Impacts

EPA’s “Technical Guidance for Assessing Environmental Justice in Regulatory Analysis[[23]](#footnote-25)” provides recommendations that encourage analysts to conduct the highest quality analysis feasible, recognizing that data limitations, time and resource constraints, and analytic challenges will vary by media and circumstance ([EPA 2016b](#_ENREF_89)).This environmental justice (EJ) analysis presents information about the facilities, workforce, and communities potentially affected by the regulatory options under current conditions, before the rule goes into effect. It draws on publicly available data provided by EPA, U.S. Census, and CDC, including the Toxics Release Inventory (TRI), EPA Enforcement and Compliance History Online (ECHO), National Air Toxics Assessment (NATA), the American Community Survey, and the Behavioral Risk Factor Surveillance System.

The purpose of this analysis is to characterize the baseline conditions faced by communities and workers affected by the regulation to identify the potential for disproportionate impacts on minority and low-income populations. The EJ analysis first characterizes the average demographic characteristics of communities near all methylene chloride facilities compared to national and rural averages. The baseline characterization across all facilities establishes typical demographics near these facilities and provides a useful point of departure for examining specific subsets of facilities of special interest. The analysis then delves into the characteristics of communities near facilities associated with two COUs where methylene chloride use is continuing under the rule, processing and industrial use of HFCs, and chemical manufacturing. The analysis also presents an assessment of worker demographics for each of these COUs. For one of the use categories—processing and industrial use of HFCs—since only four facilities are affected by the rule, EPA is able to provide a granular assessment of the characteristics of these facilities and the communities where they are located.

The analysis also presents sociodemographic characteristics for eleven communities near facilities that pose potential risk to individuals living in close proximity due to non-zero air emissions of methylene chloride according to Toxic Release Inventory data from 2018-2020. Demographic information for these fenceline communities is presented separately for three facilities that will face a WCPP under the rule and the additional eight facilities anticipated to face prohibition under the rule.

The benefits chapter does not discuss the sociodemographic characteristics of the affected workers and non-workers. While EPA lacks information on the characteristics of the workers in the specific regulated facilities, this analysis provides sociodemographic information on workers in the affected industries and locations as a proxy for the likely characteristics of affected workers. It also provides information on the sociodemographic characteristics of nearby communities and non-workers.

This analysis characterizes baseline conditions, so it does not provide information about the relative merits of the final rule and alternative regulatory options. As discussed in chapter 1, EPA found unreasonable risk for numerous uses of methylene chloride. The final rule option and alternative regulatory option prohibit the manufacture (including import), processing, distribution in commerce, industrial and commercial use, and disposal of methylene chloride for most of these uses. The regulatory options only differ for six use categories where facilities will be allowed to continue to use methylene chloride under a WCPP instead of being subject to a prohibition. Among these six uses, EPA was able to identify 32 point-source facilities for the following conditions of use: chemical manufacturing (six facilities) and chemical importing/repackaging (26 facilities); these facilities are discussed in further detail in section 10.6.2. For the condition of use “processing as a reactant,” EPA was able to identify four point-source hydrofluorocarbon processing facilities and used these as a representative for the overall condition of use. For the other three conditions of use subject to a WCPP – Incorporation into a formulation; waste handling, disposal, treatment, and recycling; and laboratory use – EPA was unable to identify point-source facilities.

The risk evaluation did not evaluate potential unreasonable risk beyond the fenceline for methylene chloride. To briefly summarize the findings of this analysis, this baseline characterization suggests that workers in affected industries and regions, as well as residents of nearby communities, are more likely to be people of color than the general population in affected states. Further, the data suggest that there are potential EJ concerns in communities surrounding certain facilities subject to this regulation. The analysis shows that communities near the four hydrofluorocarbon facilities and three facilities with the potential for beyond-the-fenceline risk[[24]](#footnote-26), tend to have lower incomes and higher poverty rates than the national average. All of these communities also had higher proportions of Black or African-American populations than national averages, and the community surrounding the facility in Arlington, TX was shown to have a majority Hispanic population.

The analysis does not suggest any potential disproportionate risks in the national workforce in industries affected by the chemical manufacturing or hydrofluorocarbon industries. However, the lack of location-specific data on these use categories could mask geographic heterogeneity in workforce sociodemographic characteristics, so this analysis is not conclusive.

Data limitations prevent EPA from conducting a more comprehensive EJ analysis that would identify the incremental impacts of the regulatory options and assess the extent to which they mitigate or exacerbate any disproportionate impacts in communities with environmental justice concerns. Uncertainties include the sociodemographic characteristics of the specific individuals affected by the use categories and the substitute technologies and practices that would be adopted at regulated entities in response to the rule. While the regulatory options are anticipated to eliminate unreasonable risks from exposure to methylene-chloride, EPA is not able to quantify the distribution of the change in risk across affected workers, communities, or demographic groups. EPA is also unable to quantify the changes in risks to workers, communities, and demographic groups from non-methylene-chloride-using technologies or practices that firms may adopt in response to the regulation to determine whether any such changes could pose environmental justice concerns.

### All Existing Methylene Chloride Facilities

Table 10‑11 presents average information on communities surrounding all existing facilities – as identified in EPA’s Chemical Data Reporting (CDR) ([EPA 2022a](#_ENREF_107)) and National Emissions Inventory (NEI) data ([EPA 2020a](#_ENREF_96)) – likely to be affected by the regulation compared to both the overall national average and the national average for rural areas. The analysis uses socioeconomic and demographic data from the American Community Survey (ACS) 5-year data release for 2020 (the most recent year available). The values in the last three columns reflect population-weighted averages across the Census block groups within 1, 3 and 5 miles of each facility. The table presents rural in addition to overall national statistics for comparison because 4,554 of the 6,460 facilities are located in rural communities. For the purposes of this analysis, EPA considers a facility to be in a rural community if 50 percent or more of the population estimated to live within 3 miles of the facility is not located in an urban block group.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 10‑11: Demographics of Communities within 1-, 3-, and 5-mile radii of Methylene Chloride Facilities, population weighted averages | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,994 | $51,878 | $71,242 | $76,408 | $78,585 |
| White | 70.4% | 87.6% | 59.7% | 59.6% | 63.2% |
| Black | 12.6% | 5.8% | 13.2% | 12.9% | 13.0% |
| American Indian | 0.8% | 1.7% | 0.6% | 0.6% | 0.6% |
| Asian | 5.6% | 1.2% | 10.4% | 10.3% | 9.4% |
| Pacific Islander | 0.2% | 0.1% | 0.2% | 0.2% | 0.2% |
| Other | 10.3% | 3.6% | 15.9% | 16.3% | 13.6% |
| Hispanic | 18.2% | 2.4% | 27.4% | 29.0% | 23.8% |
| 2x Poverty Line | 29.8% | 26.0% | 35.2% | 32.0% | 30.1% |
| Below Poverty Line | 12.8% | 9.6% | 16.5% | 14.3% | 13.3% |
| NATA Cancer Risk |  |  | 27 | 27 | 27 |
| NATA Respiratory Hazard Score |  |  | 0.35 | 0.34 | 0.34 |
| Total Population |  |  | 16,789,505 | 157,932,671 | 310,814,558 |

Table 10‑11 indicates that in general, communities within 1, 3, and 5 miles of methylene chloride facilities affected by this regulation have a much higher share of Hispanic and Asian-American persons, as well as persons of a race other than those listed than the national or rural averages. The data also suggests a lower share of White persons than either the overall national average or the rural national average. The share of Black persons living in these communities is similar to the overall national average but higher than the rural national average. Median household incomes are higher in these communities compared to the national average, while poverty rates are significantly higher in communities within 1 and 3 miles of such facilities, and similar in communities within 5 miles of such facilities.

### Chemical Manufacturing Industry

Table 10‑12 presents average information on communities surrounding the 32 chemical manufacturing and importing/repackaging facilities[[25]](#footnote-27) likely to be affected by the regulation compared to both the overall national average and the national average for rural areas. Of the six conditions of use to be regulated by a WCPP under the final rule, EPA was able to identify 32 point-sources for these two conditions of use – six for chemical manufacturing, and 26 for import/repackaging. The analysis uses socioeconomic and demographic data from the American Community Survey(ACS) 5-year data release for 2020 (the most recent year available). The values in the last three columns reflect population-weighted averages across the Census block groups within 1, 3 and 5 miles of each facility. The table presents rural in addition to overall national statistics for comparison because 5 of the 32 facilities are located in rural communities. For the purposes of this analysis, EPA considers a facility to be in a rural community if 50 percent or more of the population estimated to live within 3 miles of the facility is not located in an urban block group.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 10‑12: Demographics of communities within 1-, 3-, and 5-mile radii of Methylene Chloride Manufacturing Facilities, population weighted averages | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,994 | $51,878 | $87,481 | $85,844 | $88,131 |
| White | 70.4% | 87.6% | 64.6% | 60.5% | 59.4% |
| Black | 12.6% | 5.8% | 12.3% | 12.6% | 15.9% |
| American Indian | 0.8% | 1.7% | 0.6% | 0.5% | 0.5% |
| Asian | 5.6% | 1.2% | 8.6% | 9.2% | 10.7% |
| Pacific Islander | 0.2% | 0.1% | 0.1% | 0.2% | 0.2% |
| Other | 10.3% | 3.6% | 13.8% | 17.0% | 13.5% |
| Hispanic | 18.2% | 2.4% | 27.7% | 31.4% | 21.6% |
| 2x Poverty Line | 29.8% | 26.0% | 28.9% | 29.0% | 27.2% |
| Below Poverty Line | 12.8% | 9.6% | 14.1% | 13.6% | 12.8% |
| NATA Cancer Risk |  |  | 33 | 34 | 34 |
| NATA Respiratory Hazard Score |  |  | 0.44 | 0.43 | 0.43 |
| Total Population |  |  | 280,723 | 2,498,930 | 5,355,974 |

Table 10‑12 indicates that communities within 1, 3, and 5 miles of methylene chloride manufacturing facilities have a much higher share of Hispanic American and Asian-American persons, as well as persons of a race other than those listed than national or rural averages. The data also suggests a lower share of White persons than either the overall national average or the rural national average. The share of Black persons living in these communities is similar to the overall national average but higher than the rural national average. Median household incomes are higher in these communities compared to the national average, while poverty rates in such communities are similar to national averages, but higher than rural averages.

Table 10‑13 presents the density of other TRI facilities located within 1-, 3- and 5-mile distances of the 32 chemical manufacturing facilities. These facilities could contribute to aggregate environmental risks in these communities, assuming that individuals living in closer proximity are more likely to be exposed to toxic releases by these facilities. The Brenntag North America site in South Gate, CA has the greatest density of nearby facilities, seven within 1 mile, 28 within 3 miles, and 80 within 5 miles. The other Brenntag North America site, in Santa Fe Springs, CA, also has a high concentration of other facilities in its surrounding communities, five within 1 mile, 23 within 3 miles, and 32 within 5 miles. The EMD Holding Corp Facility has sic facilities within one mile, and the Norman Fox and Co. facility in Industry, CA has seven facilities within one mile; no other facilities had more than five additional facilities within one mile. No other facilities had more than 20 additional facilities within 3 miles. The EMD Holding Corp facility in Norwood, OH has 38 facilities within 5 miles, the Sherwin Williams Company in Cleveland, OH has 54 additional facilities within 5 miles, and the Lacamas Laboratories facility in Portland, OR has 45 facilities within 5 miles; no other facilities had more than 30 facilities within 5 miles.

Given the data above it is possible to conclude that (1) there is evidence of clustering of economic activity, and (2) to be able to assess cumulative impacts on communities it is important to understand what is being emitted/what risks these facilities pose, which may not exactly correspond with counts.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 10‑13: Total Number of Other TRI Facilities within 1, 3 and 5 Miles of Chemical Manufacturing Facilities | | | | |
| Facility Name | Location | Other TRI Facilities Within 1 Mile | Other TRI Facilities Within 3 Miles | Other TRI Facilities Within 5 Miles |
| EMD Holding Corp | TAUNTON, MA | 2 | 6 | 8 |
| EMD Holding Corp | NORWOOD, OH | 6 | 19 | 38 |
| Avantor Inc | FRANKLIN, MA | 1 | 4 | 7 |
| Avantor Inc | VISALIA, CA | 5 | 7 | 8 |
| Avantor Inc | BATAVIA, IL | 2 | 13 | 30 |
| Avantor Inc | BRIDGEPORT, NJ | 3 | 5 | 12 |
| OCCIDENTAL PETROLEUM CORP | WICHITA, KS | 1 | 1 | 7 |
| Occidental Petroleum Corp | GEISMAR, LA | 3 | 13 | 19 |
| Olin Corporation | FREEPORT, TX | 2 | 14 | 19 |
| The Sherwin Williams Company | CLEVELAND, OH | 2 | 17 | 54 |
| HELMITIN INC | OLIVE BRANCH, MS | 3 | 5 | 8 |
| BUCKMAN LABORATORIES INC. | MEMPHIS, TN | 2 | 9 | 14 |
| CRH AMERICAS INC | CHANUTE, KS | 1 | 2 | 3 |
| Heraeus Incorporated, HIC | WEST CONSHOHOCKEN, PA | 1 | 7 | 10 |
| COLONIAL GROUP, INC. | SAVANNAH, GA | 3 | 9 | 15 |
| SOLVCHEM, INC. | PEARLAND, TX | 2 | 4 | 7 |
| GREENCHEM INDUSTRIES LLC | WEST PALM BEACH, FL | 1 | 2 | 5 |
| BRENNTAG NORTH AMERICA | SOUTH GATE, CA | 7 | 28 | 80 |
| BRENNTAG NORTH AMERICA | SANTA FE SPRINGS, CA | 5 | 23 | 32 |
| NORMAN, FOX & CO. | INDUSTRY, CA | 7 | 15 | 23 |
| UNIVAR SOLUTIONS INC. | REDMOND, WA | 1 | 1 | 2 |
| SILVER FERN CHEMICAL | Seattle, WA | 1 | 5 | 11 |
| Arkema Delaware Inc. | KING OF PRUSSIA, PA | 1 | 4 | 11 |
| Avantor Inc | SUWANEE, GA | 0 | 4 | 8 |
| CBI | WILMINGTON, DE | 0 | 0 | 6 |
| Olin Corporation | CLAYTON, MO | 0 | 8 | 25 |
| BASF Corporation | FLORHAM PARK, NJ | 0 | 2 | 6 |
| SABIC Innovative Plastics US LLC | BURKVILLE, AL | 0 | 1 | 1 |
| LACAMAS LABORATORIES | PORTLAND, OR | 0 | 11 | 45 |
| LORD CORPORATION | CARY, NC | 0 | 2 | 3 |
| ALLCHEM INDUSTRIES HOLDING CORP | GAINESVILLE, FL | 0 | 0 | 2 |
| M.A.GLOBAL RESOURCES INC | APEX, NC | 0 | 2 | 2 |

The following tables provide profiles of communities surrounding each individual facility identified to have a high density of TRI facilities located nearby, again focusing on populations located within 1, 3 and 5 miles. For comparison, the tables provide the national and state averages either overall or for rural areas, depending on whether the facility is located in an urban or rural area.

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| --- | --- | --- | --- | --- | --- |
| Table 10‑14: Brenntag North America, Santa Fe Springs CA | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,944 | $51,878 | $66,549 | $80,232 | $82,791 |
| White | *70.40%* | *87.60%* | 33.5% | 40.7% | 43.2% |
| Black | *12.60%* | *5.80%* | 3.7% | 3.1% | 3.4% |
| American Indian | *0.80%* | *1.70%* | 2.9% | 1.0% | 0.8% |
| Asian | *5.60%* | *1.20%* | 10.5% | 7.7% | 12.2% |
| Pacific Islander | *0.20%* | *0.10%* | 0.1% | 0.3% | 0.3% |
| Other | *10.30%* | *3.60%* | 49.4% | 47.3% | 40.1% |
| Hispanic | *18.20%* | *2.40%* | 74.3% | 73.8% | 66.0% |
| 2x Poverty Line | *29.80%* | *26.00%* | 40.3% | 28.8% | 26.5% |
| Below Poverty Line | *12.80%* | *9.60%* | 15.9% | 9.7% | 9.3% |
| NATA Cancer Risk |  |  | *35* | 36 | 36 |
| NATA Respiratory Hazard Score |  |  | *0.4* | 0.46 | 0.47 |
| Total Population |  |  | 10,815 | 216,111 | 559,028 |

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| --- | --- | --- | --- | --- | --- |
| Table 10‑15: Brenntag North America, South Gate, CA | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,944 | $51,878 | $49,601 | $54,427 | $55,566 |
| White | 70.40% | 87.60% | 61.8% | 58.0% | 47.6% |
| Black | 12.60% | 5.80% | 0.9% | 2.5% | 7.9% |
| American Indian | 0.80% | 1.70% | 0.8% | 1.0% | 0.9% |
| Asian | 5.60% | 1.20% | 1.3% | 1.1% | 1.7% |
| Pacific Islander | 0.20% | 0.10% | 0.1% | 0.2% | 0.2% |
| Other | 10.30% | 3.60% | 35.2% | 37.2% | 41.7% |
| Hispanic | 18.20% | 2.40% | 94.3% | 92.7% | 86.4% |
| 2x Poverty Line | 29.80% | 26.00% | 52.2% | 47.7% | 48.3% |
| Below Poverty Line | 12.80% | 9.60% | 23.3% | 19.6% | 19.5% |
| NATA Cancer Risk |  |  | 40 | 39 | 38 |
| NATA Respiratory Hazard Score |  |  | 0.5 | 0.48 | 0.48 |
| Total Population |  |  | 45,384 | 375,932 | 942,331 |

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| --- | --- | --- | --- | --- | --- |
| Table 10‑16: EMD Holding Corp., Norwood, OH | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,944 | $51,878 | $62,467 | $66,973 | $66,396 |
| White | 70.40% | 87.60% | 77.8% | 62.2% | 65.1% |
| Black | 12.60% | 5.80% | 16.5% | 31.8% | 27.5% |
| American Indian | 0.80% | 1.70% | 0.1% | 0.1% | 0.1% |
| Asian | 5.60% | 1.20% | 2.1% | 2.0% | 2.7% |
| Pacific Islander | 0.20% | 0.10% | 0.0% | 0.2% | 0.1% |
| Other | 10.30% | 3.60% | 3.4% | 3.7% | 4.5% |
| Hispanic | 18.20% | 2.40% | 6.0% | 3.6% | 3.8% |
| 2x Poverty Line | 29.80% | 26.00% | 26.8% | 30.2% | 32.8% |
| Below Poverty Line | 12.80% | 9.60% | 12.9% | 14.4% | 16.7% |
| NATA Cancer Risk |  |  | 31 | 30 | 30 |
| NATA Respiratory Hazard Score |  |  | 0.46 | 0.41 | 0.41 |
| Total Population |  |  | 12,518 | 117,320 | 254,398 |

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| --- | --- | --- | --- | --- | --- |
| Table 10‑17: The Sherman Williams Company, Cleveland, OH | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,944 | $51,878 | $61,455 | $39,205 | $36,672 |
| White | 70.40% | 87.60% | 60.2% | 49.3% | 47.5% |
| Black | 12.60% | 5.80% | 25.4% | 35.6% | 37.7% |
| American Indian | 0.80% | 1.70% | 1.2% | 0.7% | 0.5% |
| Asian | 5.60% | 1.20% | 9.5% | 4.1% | 3.6% |
| Pacific Islander | 0.20% | 0.10% | 0.1% | 0.1% | 0.1% |
| Other | 10.30% | 3.60% | 3.6% | 10.3% | 10.6% |
| Hispanic | 18.20% | 2.40% | 6.4% | 17.2% | 14.5% |
| 2x Poverty Line | 29.80% | 26.00% | 38.9% | 59.9% | 58.0% |
| Below Poverty Line | 12.80% | 9.60% | 29.3% | 38.9% | 34.5% |
| NATA Cancer Risk |  |  | 30 | 30 | 27 |
| NATA Respiratory Hazard Score |  |  | 0.3 | 0.33 | 0.31 |
| Total Population |  |  | 14,272 | 81,262 | 245,970 |

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| --- | --- | --- | --- | --- | --- |
| Table 10‑18: Lacamas Laboratories, Portland, OR | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,944 | $51,878 | $83,655 | $72,324 | $75,218 |
| White | 70.40% | 87.60% | 72.5% | 75.6% | 75.4% |
| Black | 12.60% | 5.80% | 1.9% | 7.9% | 8.1% |
| American Indian | 0.80% | 1.70% | 10.5% | 1.1% | 0.9% |
| Asian | 5.60% | 1.20% | 0.1% | 4.0% | 3.7% |
| Pacific Islander | 0.20% | 0.10% | 0.0% | 1.0% | 1.2% |
| Other | 10.30% | 3.60% | 15.0% | 10.3% | 10.7% |
| Hispanic | 18.20% | 2.40% | 22.2% | 12.1% | 12.0% |
| 2x Poverty Line | 29.80% | 26.00% | 25.7% | 30.5% | 29.2% |
| Below Poverty Line | 12.80% | 9.60% | 9.7% | 16.4% | 14.1% |
| NATA Cancer Risk |  |  | 31 | 34 | 35 |
| NATA Respiratory Hazard Score |  |  | 0.5 | 0.51 | 0.54 |
| Total Population |  |  | 1,546 | 66,419 | 171,642 |

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| --- | --- | --- | --- | --- | --- |
| Table 10‑19: Norman Fox & Co., Industry, CA | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,944 | $51,878 | $78,011 | $82,606 | $77,063 |
| White | 70.40% | 87.60% | 33.5% | 36.9% | 35.4% |
| Black | 12.60% | 5.80% | 1.3% | 1.7% | 1.9% |
| American Indian | 0.80% | 1.70% | 1.8% | 1.1% | 1.2% |
| Asian | 5.60% | 1.20% | 19.5% | 21.1% | 24.9% |
| Pacific Islander | 0.20% | 0.10% | 0.6% | 0.3% | 0.3% |
| Other | 10.30% | 3.60% | 43.2% | 38.9% | 36.3% |
| Hispanic | 18.20% | 2.40% | 70.3% | 68.7% | 63.9% |
| 2x ppoverty Line | 29.80% | 26.00% | 26.0% | 29.7% | 32.1% |
| Below Poverty Line | 12.80% | 9.60% | 11.1% | 10.1% | 11.6% |
| NATA Cancer Risk |  |  | 40 | 40 | 40 |
| NATA Respiratory Hazard Score |  |  | 0.5 | 0.51 | 0.5 |
| Total Population |  |  | 11,380 | 153,922 | 456,733 |

The communities surrounding the three facilities located in California – the Norman Fox & Co. Facility in Industry, CA; and the two Brenntag North America facilities in South Gate, CA and Santa Fe Springs, CA – are majority Hispanic American, and have a much higher proportion of individuals identifying as a race other than White or Black, than the national or rural average. The communities surrounding the Norman Fox & Co. facility have a higher proportion of Asian Americans than the national average. Median incomes in communities surrounding the Brenntag North America facility in South Gate, CA are significantly lower than national averages, and poverty rates are significantly higher. The communities surrounding the facilities in Ohio – The Sherman Williams Company facility in Cleveland, OH; and the EMD Holding Corp. facility in Norwood, OH – have a significantly higher proportion of Black or African-American individuals than the national average. Median incomes in communities surrounding the Sherman Williams facility are significantly lower than national averages and poverty rates are more than double the national average.

Table 10‑20 shows the characteristics of chemical industry workers and workers in the general population in locations with chemical manufacturing facilities and nationally. The table presents simple averages across all surveyed individuals in the affected Public Use Microdata Areas (PUMAs)[[26]](#footnote-28); it does not put extra weight on surveyed individuals in the two PUMAs that contain multiple facilities. The table indicates that nationally, workers who are Black, Hispanic, or a race other than Black or White are somewhat underrepresented in the chemicals industry compared to their representation in the overall workforce. Chemical workers in communities with chemical manufacturing facilities are more likely to be White, less likely to be a race other than White or Black and have significantly higher incomes on average than chemical workers nationally. (This table reports personal income, consistent with the focus on workers, instead of household income, as reported in the community profiles above.) The general population in communities with chemical manufacturing facilities has a lower share of Black workers, Hispanic workers and workers of a race other than White or Black, higher incomes, and lower poverty rates than the general worker population nationally.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 10‑20: Characteristics of Chemical Industry Workers and General Population in Areas with Chemical Manufacturing Facilities and Nationally | | | | |
| Demographic | Working population in affected communities + NAICS | Working population in affected communities | National working population in NAICS | National working population |
| White | 88.6% | 80.9% | 84.2% | 72.5% |
| Black or African American | 8.1% | 10.1% | 8.0% | 12.7% |
| Other | 3.4% | 9.1% | 7.8% | 14.8% |
| Hispanic | 10.9% | 8.7% | 7.9% | 18.0% |
| Average Personal Income | $100,040 | $71,870 | $89,484 | $41,487 |
| Below Poverty Line | 1.9% | 4.6% | 1.7% | 13.2% |
| Below Half the Poverty Line | 0.4% | 1.9% | 0.6% | 5.9% |
| Number of Surveyed Individuals | 534 | 38996 | 21616 | 7760637 |

### HFC Analysis

Table 10‑21 presents average information on communities surrounding the four hydrofluorocarbon facilities likely to be affected by the regulation compared to both the overall national average and the national average for rural areas. Of the six conditions of use to be subject to WCPP requirements under the final rule, EPA was also able to identify 4 point-source facilities for hydrofluorocarbon processing as a subset of facilities that fall under the condition of use “processing as a reactant.” The analysis uses socioeconomic and demographic data from the American Community Survey 5-year data release for 2020 (the most recent year available). The values in the last three columns reflect population-weighted averages across the Census block groups within 1, 3 and 5 miles of each facility. The table presents rural in addition to overall national statistics for comparison because three of the four facilities are located in rural communities. For the purposes of this analysis, EPA considers a facility to be in a rural community if 50 percent or more of the population estimated to live within 3 miles of the facility is not located in an urban block group.

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| --- | --- | --- | --- | --- | --- |
| Table 10‑21: Demographics of communities within 1-, 3-, and 5-mile radii of HFC Facilities, population weighted averages | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,994 | $51,878 | $74,474 | $54,333 | $50,982 |
| White | 70.4% | 87.6% | 29.6% | 48.3% | 62.5% |
| Black | 12.6% | 5.8% | 70.0% | 45.2% | 28.1% |
| American Indian | 0.8% | 1.7% | 0.0% | 0.6% | 0.4% |
| Asian | 5.6% | 1.2% | 0.4% | 0.1% | 0.2% |
| Pacific Islander | 0.2% | 0.1% | 0.0% | 0.0% | 0.0% |
| Other | 10.3% | 3.6% | 0.0% | 5.8% | 8.9% |
| Hispanic | 18.2% | 2.4% | 3.6% | 8.1% | 11.9% |
| 2x Poverty Line | 29.8% | 26.0% | 37.1% | 41.7% | 39.0% |
| Below Poverty Line | 12.8% | 9.6% | 19.9% | 22.0% | 17.0% |
| NATA Cancer Risk |  |  | 86.6 | 76.5 | 72 |
| NATA Respiratory Hazard Score |  |  | 0.46 | 0.82 | 0.78 |
| Total Population |  |  | 470 | 12,701 | 51,304 |

Table 10‑21 indicates that communities within 1, 3 and 5 miles of hydrofluorocarbon facilities have a much higher share of Black/African American persons and a lower share of White persons and people of a race other than Black or White than either the overall national average or the rural national average. The share of Hispanic persons living in these communities is lower than the overall national average but higher than the rural national average. Median household incomes (except in the case of communities located 1-mile away) are much lower and poverty rates are much higher in these communities compared to either the overall or rural national average.

The following tables provide profiles of communities surrounding each facility individually, again focusing on populations located within 1, 3 and 5 miles. For comparison, the tables provide the national and state averages either overall or for rural areas, depending on whether the facility is located in an urban or rural area.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 10‑22: Akema Inc. (Marshall, KY) | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,994 | $51,878 |  | $46,346 | $54,556 |
| White | 70.4% | 87.6% |  | 96.6% | 96.6% |
| Black | 12.6% | 5.8% |  | 0.1% | 0.2% |
| American Indian | 0.8% | 1.7% |  | 0.8% | 0.4% |
| Asian | 5.6% | 1.2% |  | 0.0% | 0.1% |
| Pacific Islander | 0.2% | 0.1% |  | 0.0% | 0.0% |
| Other | 10.3% | 3.6% |  | 2.6% | 2.7% |
| Hispanic | 18.2% | 2.4% |  | 2.0% | 2.3% |
| 2x Poverty Line | 29.8% | 26.0% |  | 42.2% | 36.4% |
| Below Poverty Line | 12.8% | 9.6% |  | 18.3% | 15.1% |
| NATA Cancer Risk | 29.0 |  |  | 38 | 37 |
| NATA Respiratory Hazard Score | 0.4 |  |  | 1.8 | 1.7 |
| Total Population |  |  |  | 2,343 | 5,884 |

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| --- | --- | --- | --- | --- | --- |
| Table 10‑23: Chemours Newcastle (Wilmington, DE) | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,994 | $51,878 | $55,331 | $58,062 | $52,994 |
| White | 70.4% | 87.6% | 98.3% | 98.1% | 98.4% |
| Black | 12.6% | 5.8% | 0.0% | 0.0% | 0.0% |
| American Indian | 0.8% | 1.7% | 0.0% | 0.0% | 0.0% |
| Asian | 5.6% | 1.2% | 0.7% | 0.3% | 0.3% |
| Pacific Islander | 0.2% | 0.1% | 0.0% | 0.0% | 0.0% |
| Other | 10.3% | 3.6% | 1.1% | 1.6% | 1.3% |
| Hispanic | 18.2% | 2.4% | 0.6% | 0.9% | 0.6% |
| 2x Poverty Line | 29.8% | 26.0% | 34.8% | 31.4% | 36.5% |
| Below Poverty Line | 12.8% | 9.6% | 16.2% | 9.2% | 13.3% |
| NATA Cancer Risk | 29.0 |  | 20 | 20 | 20 |
| NATA Respiratory Hazard Score | 0.4 |  | 0.3 | 0.3 | 0.3 |
| Total Population |  |  | 5 | 183 | 1,872 |

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| --- | --- | --- | --- | --- | --- |
| Table 10‑24: Mexichem Fluor (St Gabriel, LA) | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,994 | $51,878 | $74,680 | $72,117 | $68,094 |
| White | 70.4% | 87.6% | 28.9% | 36.6% | 38.5% |
| Black | 12.6% | 5.8% | 70.7% | 61.6% | 59.3% |
| American Indian | 0.8% | 1.7% | 0.0% | 0.2% | 0.1% |
| Asian | 5.6% | 1.2% | 0.4% | 0.3% | 0.2% |
| Pacific Islander | 0.2% | 0.1% | 0.0% | 0.0% | 0.0% |
| Other | 10.3% | 3.6% | 0.0% | 1.4% | 1.8% |
| Hispanic | 18.2% | 2.4% | 3.6% | 3.3% | 3.3% |
| 2x Poverty Line | 29.8% | 26.0% | 37.2% | 25.6% | 24.6% |
| Below Poverty Line | 12.8% | 9.6% | 19.9% | 12.7% | 11.2% |
| NATA Cancer Risk | 29.0 |  | 200 | 200 | 190 |
| NATA Respiratory Hazard Score | 0.4 |  | 0.6 | 0.61 | 0.6 |
| Total Population |  |  | 465 | 4,458 | 6,900 |

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| --- | --- | --- | --- | --- | --- |
| Table 10‑25: Daikin America (Decatur, AL) | | | | | |
| Demographic | National | Urban | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,994 | $51,878 |  | $43,694 | $47,084 |
| White | 70.4% | 66.5% |  | 36.5% | 59.7% |
| Black | 12.6% | 14.2% |  | 52.2% | 28.1% |
| American Indian | 0.8% | 0.6% |  | 0.8% | 0.4% |
| Asian | 5.6% | 6.6% |  | 0.0% | 0.2% |
| Pacific Islander | 0.2% | 0.2% |  | 0.0% | 0.0% |
| Other | 10.3% | 11.8% |  | 10.5% | 11.6% |
| Hispanic | 18.2% | 21.7% |  | 14.4% | 15.6% |
| 2x Poverty Line | 29.8% | 30.6% |  | 54.3% | 42.2% |
| Below Poverty Line | 12.8% | 13.6% |  | 31.0% | 18.5% |
| NATA Cancer Risk | 29.0 |  |  | 48 | 41 |
| NATA Respiratory Hazard Score | 0.4 |  |  | 0.58 | 0.51 |
| Total Population |  |  |  | 5,747 | 36,648 |

Three of these four facilities – Daikin America in Decatur, AL, Arkema Inc. in Marshall, KY, and Chemours Newcastle in Wilmington, DE – have median incomes significantly below the national average, as well as poverty rates above the national, urban and rural averages. Communities located within 1 mile of the Mexichem Fluor facility in St. Gabriel, LA, have poverty rates significantly higher than the national and urban averages; poverty rates within 3 and 5 miles of this facility are more similar to national averages. Median incomes in communities surrounding this facility are higher than national averages at all three radii. Two of the four communities, Daikin America and Mexichem Fluor, have Black or African American populations significantly higher than national, urban and rural averages; the community surrounding Mexichem Fluor is majority African American. Communities surrounding the Chemours Newcastle and Akema Inc. facilities have populations that are almost exclusively (greater than 95%) White. The NATA respiratory hazard scores of 1.8 and 1.7 for facilities surrounding the Arkema Inc. facility at 3 and 5 miles respectively, are indicative of elevated respiratory hazard. The NATA cancer score in communities in facilities surrounding the Mexichem Fluor facilities are far greater than average.

Table 10‑26 presents the density of other TRI facilities located within 1-, 3- and 5-mile distances of the four hydrofluorocarbon facilities. These facilities could contribute to aggregate environmental risks in these communities, assuming that individuals living in closer proximity are more likely to be exposed to toxic releases by these facilities. The Mexichem Fluor facility in St. Gabriel, LA has the greatest density of nearby facilities (5 facilities) within 1 mile. Both the Mexichem Fluor and Daikin America facility in Decatur, AL have 16 nearby facilities within 3 miles, and 21 within 5 miles. The Chemours Newcastle Facility in Wilmington, DE did not have any nearby facilities, at any of the radii in question.

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| --- | --- | --- | --- | --- |
| Table 10‑26: Total Number of Other TRI Facilities within 1, 3 and 5 Miles of Hydrofluorocarbon Facilities | | | | |
| Facility Name | Location | Other TRI Facilities Within 1 Mile | Other TRI Facilities Within 3 Miles | Other TRI Facilities Within 5 Miles |
| ARKEMA INC. | Marshall, KY | 3 | 11 | 11 |
| Mexichem Fluor | St. Gabriel, LA | 5 | 16 | 21 |
| Daikin America, Inc. | Decatur, AL | 2 | 16 | 21 |
| ChemoursNew Castle, DE | Wilmington, DE | 0 | 0 | 0 |

Table 10‑27 shows the characteristics of chemical industry workers and workers in the general population in locations with hydrofluorocarbon facilities and nationally. The table presents simple averages across all surveyed individuals in the affected PUMAs; it does not put extra weight on surveyed individuals in the two PUMAs that contain multiple facilities. The table indicates that nationally, workers who are Black, Hispanic, or a race other than Black or White are somewhat underrepresented in the chemicals industry compared to their representation in the overall workforce. Chemical workers in communities with hydrofluorocarbon facilities are less likely to be Hispanic, less likely to be a race other than White or Black, and have slightly higher incomes on average than chemical workers nationally. (This table reports personal income, consistent with the focus on workers, instead of household income, as reported in the community profiles above.) The general population in communities with hydrofluorocarbon facilities has a lower share of Hispanic workers and workers of a race other than White or Black, higher incomes, and lower poverty rates than the general or chemical worker population nationally.

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| --- | --- | --- | --- | --- |
| Table 10‑27: Characteristics of Chemical Industry Workers and General Population in Areas with Hydrofluorocarbon Facilities and Nationally | | | | |
| Variable | Working population in affected communities + NAICS | Working population in affected communities | Natl working population in NAICS | Natl working population |
| White | 89.1% | 87.7% | 84.2% | 72.5% |
| Black or African American | 9.4% | 10.2% | 8.0% | 12.7% |
| Other | 1.5% | 2.1% | 7.8% | 14.8% |
| Hispanic | 0.5% | 1.8% | 7.9% | 18.0% |
| Average Personal Income | $90,694 | $44,684 | $89,484 | $41,487 |
| Below Poverty Line | 1.0% | 7.3% | 1.7% | 13.2% |
| Below Half the Poverty Line | 0.5% | 2.8% | 0.6% | 5.9% |
| Number of Surveyed Individuals | 202 | 10,540 | 21,616 | 7,760,637 |

Table 10‑28 breaks down the data for chemical industry workers for each PUMA with a hydrofluorocarbon facility. These results indicate that poverty rates among chemical workers in hydrofluorocarbon PUMAs are low, consistent with average trends across all hydrofluorocarbon communities and nationally among chemical industry workers. Income statistics were more heterogeneous; chemical workers in Chemours Newcastle in Wilmington, DE and Daikin America in Decatur, AL earned significantly less than chemical workers nationally, while workers in the other facilities earned more. With the exception of the Mexichem Fluor facility in St. Gabriel, LA, all facilities showed an underrepresentation of Black workers, Hispanic workers, and workers of a race other than White or Black, consistent with the national averages among chemical workers. The Mexichem Fluor facility had a significantly higher proportion of black workers than both the chemical industry and general population averages. As noted previously, it is not possible to determine the extent to which workers in these demographic groups will benefit from the regulation because EPA lacks data on the composition of employees at the specific plants affected by the regulation.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 10‑28: Characteristics of Chemical Industry Workers in Areas with Individual Hydrofluorocarbon Facilities | | | | | | | | | |
| Facility Name | Location | White | Black or African American | Other | Hispanic | Average Personal Income (2020$) | Below Poverty Line | Below Half the Poverty Line | Number of Surveyed Individuals |
| ARKEMA INC. | Marshall, KY, 42029 | 97.5% | 1.2% | 1.2% | 1.2% | $94,989 | 0.0% | 0.0% | 81 |
| ChemoursNew Castle, DE | Wilmington, DE | 92.3% | 0.0% | 7.7% | 0.0% | $70,956 | 0.0% | 0.0% | 13 |
| Mexichem Fluor | St. Gabriel, LA | 82.4% | 16.7% | 0.9% | 0.0% | $89,849 | 1.9% | 0.9% | 108 |
| Daikin America, Inc. | Decatur, AL | 94.4% | 5.6% | 0.0% | 0.0% | $63,060 | 5.6% | 0.0% | 18 |

### Fenceline Community Analysis

Table 10‑29 presents average information on communities surrounding the three facilities identified in the EPA’s Fenceline Analysis ([EPA 2022c](#_ENREF_109)) and likely to be affected by the regulation compared to both the overall national average and the national average for rural areas. All three facilities fall under the COUs of chemical manufacturing. The analysis uses socioeconomic and demographic data from the American Community Survey 5-year data release for 2020 (the most recent year available). The values in the last three columns reflect population-weighted averages across the Census block groups within 1, 3 and 5 miles of each facility. The table presents rural in addition to overall national statistics for comparison because one of the three facilities is located in a rural community. For the purposes of this analysis, EPA considers a facility to be in a rural community if 50 percent or more of the population estimated to live within 3 miles of the facility is not located in an urban block group.

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| --- | --- | --- | --- | --- | --- |
| Table 10‑29: Demographics of communities within 1, 3, and 5 miles of three facilities facing an ECEL and with potential risk in the EPA Fenceline Analysis for Methylene Chloride, population weighted averages | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,994 | $51,878 | $41,338 | $49,411 | $55,031 |
| White | 70.4% | 87.6% | 45.7% | 56.5% | 55.9% |
| Black | 12.6% | 5.8% | 44.9% | 26.4% | 23.0% |
| American Indian | 0.8% | 1.7% | 0.0% | 0.2% | 0.4% |
| Asian | 5.6% | 1.2% | 0.7% | 2.0% | 5.0% |
| Pacific Islander | 0.2% | 0.1% | 0.0% | 0.4% | 0.2% |
| Other | 10.3% | 3.6% | 8.6% | 14.5% | 15.5% |
| Hispanic | 18.2% | 2.4% | 26.4% | 37.1% | 38.0% |
| 2x Poverty Line | 29.8% | 26.0% | 51.0% | 44.4% | 41.4% |
| Below Poverty Line | 12.8% | 9.6% | 26.4% | 19.4% | 17.8% |
| NATA Cancer Risk |  |  | 38 | 38 | 36 |
| NATA Respiratory Hazard Score |  |  | 0.4 | 0.41 | 0.41 |
| Total Population |  |  | 18,146 | 131,852 | 370,609 |

Table 10‑30 indicates that communities within 1, 3 and 5 miles of communities with potential beyond-the-fenceline risk – i.e., facilities with nearby populations and potentially hazardous releases -- have a much higher share of Black/African American persons, Hispanic persons, and persons identifying as a race other than those listed, as well as a and a lower share of White persons than either the overall national average, urban national average or the rural national average. Median household incomes are much lower and poverty rates are much higher in these communities compared to either the overall or rural national average. Given the combination of high poverty and concentration of minority populations, these statistics suggest that serious environmental justice concerns exist in the communities surrounding the regulated facilities.

The following tables provide characteristics of communities surrounding each facility individually, again focusing on populations located within 1, 3 and 5 miles. For comparison, the tables provide the national and state averages either overall or for rural areas, depending on whether the facility is located in an urban or rural area.

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| --- | --- | --- | --- | --- | --- |
| Table 10‑30: 3V Inc., (Georgetown, SC) | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,994 | $51,878 | $48,056 | $46,700 | $41,027 |
| White | 70.4% | 87.6% | 69.2% | 61.8% | 47.3% |
| Black | 12.6% | 5.8% | 24.2% | 27.2% | 45.6% |
| American Indian | 0.8% | 1.7% | 0.0% | 0.0% | 0.0% |
| Asian | 5.6% | 1.2% | 0.0% | 0.0% | 0.0% |
| Pacific Islander | 0.2% | 0.1% | 0.0% | 0.0% | 0.0% |
| Other | 10.3% | 3.6% | 6.5% | 11.0% | 7.1% |
| Hispanic | 18.2% | 2.4% | 6.5% | 10.8% | 5.6% |
| 2x Poverty Line | 29.8% | 26.0% | 24.0% | 42.3% | 44.9% |
| Fraction Below Poverty Line | 12.8% | 9.6% | 13.3% | 11.6% | 19.3% |
| NATA Cancer Risk | 29.0 |  | 30 | 30 | 30 |
| NATA Respiratory Hazard Score | 0.4 |  | 0.4 | 0.43 | 0.46 |
| Total Population |  |  | 25 | 988 | 7,835 |

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| --- | --- | --- | --- | --- | --- |
| Table 10‑31: Berryman Products (Arlington, TX) | | | | | |
| Demographic | National | Urban | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,994 | $51,878 | $45,125 | $51,112 | $56,287 |
| White | 70.4% | 66.5% | 57.5% | 56.3% | 53.9% |
| Black | 12.6% | 14.2% | 29.3% | 21.7% | 20.8% |
| American Indian | 0.8% | 0.6% | 0.0% | 0.3% | 0.4% |
| Asian | 5.6% | 6.6% | 1.0% | 2.4% | 6.0% |
| Pacific Islander | 0.2% | 0.2% | 0.0% | 0.6% | 0.2% |
| Other | 10.3% | 11.8% | 12.2% | 18.7% | 18.6% |
| Hispanic | 18.2% | 21.7% | 52.0% | 52.0% | 48.3% |
| 2x Poverty Line | 29.8% | 30.6% | 45.5% | 44.4% | 42.0% |
| Below Poverty Line | 12.8% | 13.6% | 23.4% | 19.5% | 18.0% |
| NATA Cancer Risk | 29.0 |  | 55 | 54 | 48 |
| NATA Respiratory Hazard Score | 0.4 |  | 0.4 | 0.4 | 0.4 |
| Total Population |  |  | 8,459 | 90,815 | 284,264 |

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| --- | --- | --- | --- | --- | --- |
| Table 10‑32: Slocum Adhesives (Lynchburg, VA) | | | | | |
| Demographic | National | Urban | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,994 | $51,878 | $38,004 | $45,621 | $51,882 |
| White | 70.4% | 66.5% | 35.3% | 56.7% | 64.2% |
| Black | 12.6% | 14.2% | 58.7% | 36.9% | 28.6% |
| American Indian | 0.8% | 0.6% | 0.1% | 0.1% | 0.2% |
| Asian | 5.6% | 6.6% | 0.4% | 1.0% | 1.9% |
| Pacific Islander | 0.2% | 0.2% | 0.1% | 0.1% | 0.1% |
| Other | 10.3% | 11.8% | 5.4% | 5.1% | 5.1% |
| Hispanic | 18.2% | 21.7% | 4.1% | 3.8% | 4.0% |
| 2x Poverty Line | 29.8% | 30.6% | 55.9% | 44.3% | 39.0% |
| Below Poverty Line | 12.8% | 13.6% | 29.1% | 19.2% | 16.8% |
| NATA Cancer Risk | 29.0 |  | 30 | 30 | 30 |
| NATA Respiratory Hazard Score | 0.4 |  | 0.4 | 0.39 | 0.38 |
| Total Population |  |  | 9,962 | 40,049 | 78,510 |

These statistics show that the communities surrounding all three plants may face serious environmental justice concerns. All three of these facilities have median incomes significantly below the national average, as well as poverty rates above the national, urban and rural averages. Communities located within 3 and 5 miles of the 3V Inc. facility in Georgetown, SC, have poverty rates significantly higher than the national and rural averages; poverty rates within 1 mile of this facility are more similar to national and rural averages. All three communities have Black or African American populations significantly higher and White populations significantly lower than national, urban and rural averages. The communities surrounding the Berryman Products facility in Arlington, TX have Hispanic populations significantly higher than the national and urban averages; the communities within 1 and 3 miles of this facility are majority Hispanic.

Table 10‑33 presents the density of other TRI facilities located within 1-, 3- and 5-mile distances of the three fenceline facilities. These facilities could contribute to aggregate environmental risks in these communities, assuming that individuals living in closer proximity are more likely to be exposed to toxic releases by these facilities. The Berryman Products facility in Arlington, TX has the greatest density of nearby facilities, five withing 1mile, 21 within 3 miles, and 24 within 5 miles. No other facilities had more than five facilities within 1 mile, 10 within 3 miles, or 10 within 5 miles.

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| --- | --- | --- | --- | --- |
| Table 10‑33: Total Number of Other TRI Facilities within 1, 3 and 5 Miles of Fenceline Facilities | | | | |
| Facility Name | Location | Other TRI Facilities Within 1 Mile | Other TRI Facilities Within 3 Miles | Other TRI Facilities Within 5 Miles |
| 3V INC | GEORGETOWN ,SC | 1 | 4 | 7 |
| Berryman Prods Inc | Arlington ,TX | 5 | 21 | 24 |
| Slocum Adhesives Corp | Lynchburg ,VA | 2 | 8 | 9 |

Table 10‑34 presents average information on communities surrounding the eight facilities identified in the EPA’s Fenceline Analysis ([EPA 2022c](#_ENREF_109)) that are likely to be affected by prohibition of methylene chloride use compared to both the overall national average and the national average for rural areas. The analysis uses socioeconomic and demographic data from the American Community Survey 5-year data release for 2020 (the most recent year available). The values in the last three columns reflect population-weighted averages across the Census block groups within 1, 3 and 5 miles of each facility. The table presents rural in addition to overall national statistics for comparison because 3 of the 10 facilities are located in a rural community. For the purposes of this analysis, EPA considers a facility to be in a rural community if 50 percent or more of the population estimated to live within 3 miles of the facility is not located in an urban block.

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| --- | --- | --- | --- | --- | --- |
| Table 10‑34: Demographics of communities within 1, 3, and 5 miles of eight facilities facing prohibition and with potential risk in the EPA Fenceline Analysis for Methylene Chloride, population weighted averages | | | | | |
| Demographic | National | Rural | 1-Mile Average | 3-Mile Average | 5-Mile Average |
| Median Income | $64,994 | $51,878 | $66,632 | $65,735 | $67,366 |
| White | 70.4% | 87.6% | 86.1% | 82.4% | 80.0% |
| Black | 12.6% | 5.8% | 3.5% | 5.7% | 8.1% |
| American Indian | 0.8% | 1.7% | 0.6% | 1.0% | 1.1% |
| Asian | 5.6% | 1.2% | 1.1% | 1.8% | 1.7% |
| Pacific Islander | 0.2% | 0.1% | 0.0% | 0.0% | 0.0% |
| Other | 10.3% | 3.6% | 8.7% | 9.2% | 9.0% |
| Hispanic | 18.2% | 2.4% | 21.7% | 20.0% | 18.0% |
| 2x Poverty Line | 29.8% | 26.0% | 36.6% | 34.2% | 33.6% |
| Below Poverty Line | 12.8% | 9.6% | 17.3% | 15.7% | 15.3% |
| NATA Cancer Risk |  |  | 26 | 27 | 27 |
| NATA Respiratory Hazard Score |  |  | 0.33 | 0.36 | 0.36 |
| Total Population |  |  | 12,958 | 177,477 | 424,124 |

EPA also conducted a supplemental analysis of two facilities in the plastic and rubber products manufacturing condition of use that were identified in EPA’s Fenceline Analysis ([EPA 2022c](#_ENREF_109)). Facilities using methylene chloride for plastic and rubber products manufacturing will likely continue to emit this chemical after implementation of the WCPP as part of the final rule. EPA notes that these air emissions are currently regulated by a maximum achievable control technology (MACT) of the NESHAP for methylene chloride. Nevertheless, EPA conducted a supplemental geospatial analysis of these facilities to determine the levels of possible exposure to methylene chloride emissions for populations living near the fenceline of these facilities. Facility information is provided in Table 10‑35.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 10‑35: Plastic and Rubber Products Manufacturing Facilities with Methylene Chloride Air Emissions Identified in the Fenceline Analysis | | | |
| Facility | City | State | FRS ID |
| Sabic Innovative Plastics US, LLC | Burkville | Alabama | 110000379885 |
| Sabic Innovative Plastics Mount Vernon, LLC | Mount Vernon | Indiana | 110000403670 |
|  |  |  |  |

The analysis uses the EPA's Risk-Screening Environmental Indicators (RSEI) Geographic Microdata (RSEI-GM).[[27]](#footnote-29) RSEI-GM microdata provide high-resolution (810 meter by 810 meter) modeled concentrations that cover the entire United States for each facility by chemical air release in the Toxic Releases Inventory (TRI). For this analysis, EPA focuses exclusively on emissions of methylene chloride and uses modeled concentrations resulting from emissions in TRI year 2020. These modeled concentrations reflect emissions in combination with transport patterns based on weather and plant characteristics. For each facility, EPA provides a detailed map of the methylene chloride concentrations in Figure 10‑2 and Figure 10‑3. The central red dots represent the facility location according to TRI. The blue shaded regions represent areas with low or zero concentration values, while the yellow colors represent higher concentrations. Labels for the gridded regions within 800, 1600, 2400, and 3200 meters of the facility are also labeled with red circular buffers. These buffer regions were selected because the minimum available grid size is 810x810 meters.

In general, the maps show that the highest concentrations are on top of or immediately adjacent to the facilities (i.e., within 800 meters). Modeled methylene chloride concentrations, even those at the facility location, are well below the proposed ECEL of 2 ppm, and they decline rapidly with distance.[[28]](#footnote-30) Across both facilities, the highest modeled concentration in any grid is 73.1 directly surrounding the Sabic Innovative Plastics US, LLC, plant in Burkville, Alabama. This air concentration is roughly one tenth the Existing Chemical Exposure Limit (ECEL) of 2 ppm for an 8-hour time-weighted average methylene chloride concentration.

|  |
| --- |
| Figure 10‑2**:** Geographical dispersion of Methylene Chloride for Sabic Innovative Plastics US, LLC – Burkville, AL |
| A map with a red circle  Description automatically generated |

|  |
| --- |
| Figure 10‑3**:** Geographical dispersion of Methylene Chloride for Sabic Innovative Plastics US, LLC – Mount Vernon, IN |
| A map with a red circle  Description automatically generated |

## Impacts on Technological Innovation and the National Economy

With respect to the anticipated effects of this rule on the national economy, as described in the final rule, EPA considered the number of businesses and workers that would be affected and the costs and benefits to those businesses and workers and did not find that there would be a measurable impact on the national economy. Guidance issued by the Office of Management and Budget indicates that the economic impact of a regulation on the national economy becomes measurable only if the economic impact of the regulation reaches 0.25 percent to 0.5 percent of Gross Domestic Product (GDP) (See Memorandum from Sally Katzen, “Guidance for Implementing Title II of [UMRA],” March 31, 1995). Given the current GDP, this is equivalent to a cost of $40 billion to $80 billion. Therefore, EPA has concluded that this rule is highly unlikely to have any measurable effect on the national economy.

With respect to this rule’s effect on technological innovation, EPA expects this rule to spur innovation, not hinder it. A prohibition or significant restriction on the manufacture, processing, and distribution in commerce of methylene chloride for uses covered in this rule is likely to increase demand for chemical substitutes. This rulemaking involves environmental monitoring or measurement, specifically for occupational inhalation exposures to methylene chloride. Consistent with the Agency’s Performance Based Measurement System (PBMS), EPA does not to require the use of specific, prescribed analytic methods. Rather, the Agency plans to allow the use of any method that meets the prescribed performance criteria. The PBMS approach is intended to be more flexible and cost-effective for the regulated community; it is also intended to encourage innovation in analytical technology and improved data quality. EPA is not precluding the use of any method, whether it constitutes a voluntary consensus standard or not, as long as it meets the performance criteria specified. Some examples of methods which meet the criteria are included in appendix A of the ECEL memo.

## Executive Order 13132 – Federalism

Executive Order 13132, entitled *Federalism* (64 FR 43255, August 10, 1999), directs federal agencies to consider whether a rule has federalism implications (*i.e.*, whether it has substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132). The EPA has concluded that this action has federalism implications because regulation under TSCA section 6(a) may preempt state law. The Agency consulted with state and local officials early in the process of developing the proposed action to permit them to have meaningful and timely input into its development. EPA invited the following national organizations representing state and local elected officials to a meeting on October 22, 2020: Association of State Drinking Water Administrators, National Association of Clean Water Agencies, Western States Water Council, National Water Resources Association, American Water Works Association, Association of Metropolitan Water Agencies, Association of Clean Water Administrators, Environmental Council of the States, National Association of Counties, National League of Cities, County Executives of America, U.S. Conference of Mayors, and National Association of Attorneys General. A summary of the meeting with these organizations, including the views that they expressed, is available in the docket. During the consultation, participants and EPA discussed preemption, the authority given under TSCA section 6 to regulate identified unreasonable risks, what activities would be potentially regulated in the proposed rule, and the relationship between TSCA and existing statutes – particularly the Clean Water Act and Safe Drinking Water Act. EPA provided an opportunity for these organizations to provide follow-up comments in writing but did not receive any such comments.

## Executive Order 13175 – Tribal Implications

Executive Order 13175, entitled *Consultation and Coordination with Indian Tribal Governments* (59 FR 22951, November 6, 2000), directs federal agencies to consider whether a rule has tribal implications (*i.e.*, whether it has substantial direct effects on tribal governments, on the relationship between the Federal government and the Indian tribes, or on the distribution of power and responsibilities between the Federal government and Indian tribes). This rulemaking would not have substantial direct effects on tribal government because methylene chloride is not manufactured, processed, or distributed in commerce by tribes and would not impose substantial direct compliance costs on tribal governments. Thus, Executive Order 13175 does not apply to this action. EPA nevertheless consulted with tribal officials during the development of this action, consistent with the EPA Policy on Consultation and Coordination with Indian Tribes. EPA met with tribal officials via teleconference on November 12, 2020, and November 17, 2020, concerning the prospective regulation of the methylene chloride conditions of use under TSCA section 6. EPA risk managers briefed tribal officials on the Agency’s risk management considerations and tribal officials raised no related issues or concerns to EPA during, or in follow-up-to those meetings.

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- Chemical Ranking Procedure and Calculations

A chemical ranking procedure was developed as a proxy for market share percentage of the chemicals used in products. This procedure provides a coarse estimate of 1) market share percentage of chemicals used within the current marketplace, and 2) the anticipated market share percentage of alternative chemicals if methylene chloride were restricted for a certain product category.

The use of a chemical ranking procedure as a proxy for market share of the chemicals used in products, builds in an assumption that the greater solvent effectiveness, greater number of customer product reviews, greater customer ratings, lower VOC content, lower product flammability, and lower price are associated with greater market share. This may not be the case for all product categories, and additional research using industry-specific sources would be necessary to obtain enhanced market share information for each product category and ingredient.

An Internet search was conducted to find products within a product category that met the following two conditions: 1) were available for sale on-line, and 2) had customer review and rating information available on-line. These products would provide the basis for this chemical ranking procedure.

For some product categories, there were no customer reviews for products with COCs and/or alternative products. For these cases, these products were included in our evaluation and were given the lowest possible score "0" for both customer reviews and customer ratings.

The individual chemical ingredient names and concentrations for these products were identified by reviewing the product Safety Data Sheets. The chemical ranking procedure was limited to solvent ingredients only. Other product ingredients such as propellants, evaporation barriers, colorants, and surfactants were excluded from this chemical ranking procedure.

The concentration of a solvent ingredient in a product was multiplied by the sum of ratings for the following factors: product price, solvent VOC exempt status, number of customer reviews of the product, number of customer ratings of the product, product HSP distance to the target contaminant, and product fire safety. The rating scale used was from "0" the least desirable rating, to "5" the most desirable rating. If a solvent ingredient was used in more than one product, then the results for the solvent were summed to represent the cumulative market share for the particular solvent. The following paragraphs provide a description for each factor.

Product Price

The pricing information was accessed from publicly available websites. To assist in comparing prices across various products and product sizes, the prices were normalized to price per ounce.

The price range for products containing methylene chloride was determined. The price for individual products containing alternative chemicals was compared to the price range of the products containing methylene chloride. The higher the rating, the more desirable the product price containing alternative solvents. Exhibit A‑1 shows the rating scale based upon this comparison.

| Exhibit A‑1: Product Price - Rating Scale | |
| --- | --- |
| Rating | Description |
| 5 | Within or below the price range of products containing a Chemical of Concern (1-BP, DCM, NMP, TCE, PCE) |
| 4 | < 25% above price range of products containing a Chemical of Concern |
| 3 | 25 to 50% above price range of products containing a Chemical of Concern |
| 2 | 51 to 75% above price range of products containing a Chemical of Concern |
| 1 | 76 to 100% above price range of products containing a Chemical of Concern |
| 0 | Greater than 100% above price range of products containing a Chemical of Concern |

Solvent VOC Exempt Status

The individual solvents were given a rating of "5" if they have VOC exempt status from the U.S. EPA and were given a rating of "0" if they did not have VOC exempt status.

Customer Reviews of the Product

The number of customer reviews of the product was determined from online sources. The retailer providing the highest number of customer reviews for a particular product was used for the chemical ranking procedure. In general, the higher the number of customer reviews the higher the likelihood that the product is widely sold and used. Exhibit A‑2 shows the rating scale based upon the number of product customer reviews.

| Exhibit A‑2: Customer Reviews - Rating Scale | |
| --- | --- |
| Rating | Number of Customer Reviews |
| 5 | Greater than 5,000 reviews |
| 4 | 3,001 to 5,000 reviews |
| 3 | 1,001 to 3,000 reviews |
| 2 | 501 to 1,000 reviews |
| 1 | 11 to 500 reviews |
| 0 | 0 to 10 reviews |

Customer Ratings of the Product

The average number of stars provided by customer reviews of the product was determined from online sources. The typical customer rating scale is "0" to "5" stars, where "0" is the lowest rating and "5" is the highest rating based upon customer satisfaction with the product. Exhibit A‑3 shows the rating scale based upon the average customer rating for a product.

| Exhibit A‑3: Customer Ratings - Rating Scale | |
| --- | --- |
| Rating | Customer Rating |
| 5 | 4.7 to 5.0 stars |
| 4 | 4.3 to 4.6 stars |
| 3 | 3.7 to 4.2 stars |
| 2 | 3.3 to 3.6 stars |
| 1 | 3.0 to 3.2 stars |
| 0 | Less than 3 stars |

HSP Distance to Contaminant

The HSP theory can be used to predict which solvents will be able to quickly dissolve and/or soften the target. HSP values are based on the principle that "like dissolves like," meaning that the closer the contaminant and the solvent are in three-dimensional solubility space, the greater the likelihood that the solvent will be effective. Therefore, with all other factors being equal, the lower the HSP distance between the solvent and contaminant the more effective the solvent will be and ultimately reduce the removal time of the contaminant. Exhibit A‑4 shows the rating scale based upon the HSP distance between the solvent and contaminant.

The calculation of the HSP distance to contaminant is a time-consuming process. Due to limited project resources this calculation was conducted for some but not all product categories. For product categories with no HSP distance calculations, the HSP distance factor was not included in the chemical ranking process.

| Exhibit A‑4: HSP Distance to Contaminant- Rating Scale | |
| --- | --- |
| Rating | HSP Distance |
| 5 | Less than 3.0 |
| 4 | 3.0 to 6.9 |
| 3 | 7.0 to 9.9 |
| 2 | 10.0 to 12.9 |
| 1 | 13.0 to 15.0 |
| 0 | Greater than 15.0 |

Fire Safety

The fire safety rating is based upon the product flammability rating and the presence/absence of evaporation barrier additives in the product. The product flammability rating was determined by either the rating provided on the product label, or the flash point temperature provided in the product Safety Data Sheet. Under the Federal Hazardous Substances Act label requirements, the Consumer Product Safety Commission classifies a liquid with a flash point less than 20 °F as "Extremely Flammable"; greater than 20 °F and less than 100 °F as "Flammable"; and 100 °F to 150 °F as "Combustible." Exhibit A‑5 shows the rating scale based upon the product flammability rating and the presence/absence of evaporation barrier additives.

| Exhibit A‑5: Fire Safety - Rating Scale | |
| --- | --- |
| Rating | Fire Safety |
| 5 | "Non-flammable" product rating |
| 4 | "Combustible" product rating or Evaporation Barrier used in the product |
| 1 | "Flammable" product rating and no Evaporation Barrier used in the product |
| 0 | "Extremely flammable" product rating and no Evaporation Barrier used in the product |

The details of the chemical ranking procedure for determining the market share percentage for brake cleaners is provided as an example of this procedure. Exhibit A‑6 shows the chemical ranking procedure applied to the brake cleaning products. Note that total points for a given solvent are summed across products assessed. In addition, this procedure may undervalue the aqueous option as the HSP value and the price for the aqueous option are both shown as zero. The degreasing mechanism is not reflected in the HSP system. Similarly, the cost savings from adoption of an aqueous system are not reflected here because no cost per ounce was calculated for the aqueous system.

| Exhibit A‑6: Chemical Ranking Procedure for Brake Cleaning Products | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Chemical | Product | Concentration in Product | Price | VOC | Customer Reviews | Customer Ratings | HSP Distance to brake contaminant | Fire Safety | Total Points | % Before Restriction | % After Restriction |
| acetone | CRC Brakleen Non-Chlorinated 05054 | 85% | 5 | 5 | 2 | 5 | 3 | 0 | 17.0 |  |  |
| acetone | 3M 08180 | 65% | 4 | 5 | 1 | 4 | 4 | 0 | 11.7 |  |  |
| acetone | 3M 08179 | 80% | 3 | 5 | 1 | 4 | 3 | 0 | 12.8 |  |  |
|  |  |  |  |  |  |  | acetone subtotal | | **41.5** | 31% | 47% |
| perc | CRC Brakleen 05089 | 95% | 5 | 5 | 5 | 5 | 3 | 5 | 26.6 |  |  |
| perc | Berryman 5C-4 | 13% | 5 | 5 | 0 | 5 | 4 | 5 | 3.0 |  |  |
|  |  |  |  |  |  |  | perc subtotal | | **29.6** | 22% |  |
| DCM | Berryman 5C-4 | 65% | 5 | 5 | 0 | 5 | 4 | 5 | 15.6 | 12% |  |
| heptane, branched, cyclic, and linear | 3M 08880 | 55% | 5 | 0 | 1 | 4 | 5 | 0 | 8.3 | 6% | 9% |
| xylene | 3M 08880 | 23% | 5 | 0 | 1 | 4 | 5 | 0 | 3.4 |  |  |
| xylene | 3M 08180 | 5% | 4 | 0 | 1 | 4 | 4 | 0 | 0.6 |  |  |
|  |  |  |  |  |  |  | xylene subtotal | | **4.0** | 3% | 4% |
| toluene | Berryman 5C-4 | 20% | 5 | 0 | 0 | 5 | 4 | 5 | 3.8 | 3% | 4% |
| 2-methyl hexane | 3M 08180 | 8% | 4 | 0 | 1 | 4 | 4 | 0 | 1.0 | 1% | 1% |
| 3-methyl hexane | 3M 08180 | 8% | 5 | 0 | 1 | 4 | 4 | 0 | 1.1 | 1% | 1% |
| methanol | 3M 08880 | 8% | 5 | 0 | 1 | 4 | 5 | 0 | 1.1 | 1% | 1% |
| ethyl benzene | 3M 08880 | 6% | 5 | 0 | 1 | 4 | 5 | 0 | 0.9 | 1% | 1% |
| n-heptane | CRC Brakleen Non-Chlorinated 05054 | 4% | 5 | 0 | 2 | 5 | 3 | 0 | 0.6 | 0% | 1% |
| ethanol | Trueguard | 10% | 5 | 0 | 0 | 4 | 4 | 0 | 1.3 | 1% | 1% |
| naphtha | Trueguard | 90% | 5 | 0 | 0 | 4 | 4 | 0 | 11.7 | 9% | 13% |
| water | CRC Smart Washer Ozzy Juice | 100% | 0 | 5 | 0 | 4 | 0 | 5 | 14.0 | 10% | 16% |
| totals | | | | | | | | | | 100% | 100% |
| Points Before Restriction | | | | | | | | | 134.4 |  | |
| Points After Restriction | | | | | | | | | 89.2 |  | |

- HSP Theory and Calculations

A solute is the substance being dissolved, and a solvent is the substance that dissolves it. Both substances (solute and solvent) should have similar HSP to dissolve the solute. The HSP approach is based on three distinctive forms of inter-molecular force:

1. Dispersion forces (D): All atoms are surrounded by electron "clouds." The electron cloud is, on average, evenly distributed around the atom. At a given instant, however, the electron distribution may be uneven. This temporary polarization results in attractive interactions with nearby atoms.
2. Polar forces (P): Dipole moments are created when atoms of the same molecule have different electronegativities.
3. Hydrogen bond forces (H): This force exists between hydrogen atoms and other atoms present in adjacent molecules.

These three forces or parameters are used to describe solvent and solute interactions. Each parameter can be used as an axis in three-dimensional solubility space. Instead of the common X, Y, and Z axis, the three-dimensional solubility space will have a Dispersion Force (D) axis, a Polar Force (P) axis, and a Hydrogen Bonding Force (H) axis. Each solvent can be represented as a point in three-dimensional solubility space, and each solute can be represented as a solubility sphere in three-dimensional solubility space.

HSP values are based on the principle that "like dissolves like," meaning that the closer the solute and solvent are in three-dimensional solubility space, the greater the likelihood that the solvent will be effective.

If the solvent is located inside the solute sphere of solubility, then it will dissolve the polymer. If the solvent is located outside the solute sphere of solubility, then it will NOT dissolve the polymer. The distance between HSP points in solubility space is calculated as follows:

Distance = [4 (D1-D2)2 + (P1-P2)2 + (H1-H2)2 ]1/2

As shown in Figure B1 below, the three axes are for the polar force, hydrogen bonding force, and dispersion force. The black dot represents the center point for the solute sphere of solubility. The green dots represent solvents that are inside the solute solubility sphere and will dissolve the solute. The red dots represent solvents that are outside the solute solubility sphere and will NOT dissolve the solute.

This is a diagram showing the three Hansen Solubility Parameters, a sphere of solubility, and solvents located inside and outside of the sphere.


*Figure B1: Solvents and Sphere of Solubility in Hansen Solubility Parameter 3D Space*

In general, the lower the HSP distance between the solvent and the solute, the better the solubility performance. The lower the HSP distance between solvent and the center of the solute solubility sphere, the faster the solute dissolves ([TURI 2020](#_ENREF_68)).

The details of the HSP distance calculations for AC coil cleaner products is provided in this appendix as an example of these calculations. Exhibit B‑1 shows the HSP calculations for the various AC coil cleaner products. (Note: the HSP calculations for all other product categories are still in the HSP Calculations Excel file and have not been imported into Appendix B).

The first column of the table shows the solvent name and the second column shows the chemical CAS number. The third through fifth columns show the three Hansen Solubility Parameters: D value, P value, and H value. The sixth column shows the concentration of the solvent within the product. The last row of each table shows the overall Hansen Solubility Parameters for the entire solvent blend with the product.

| Exhibit B‑1: HSP Calculations for AC coil cleaner products | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Product | Solvent | CAS # | D value | P value | H value | Concentration |
| Nu-Calgon Cal Blast | DCM | 75-09-2 | 17 | 7.3 | 7.1 | 95% |
| D-limonene | 5989-27-5 | 17.2 | 1.8 | 4.3 | 5% |
| PCE | 127-18-4 | 18.3 | 5.7 | 0 | 0% |
| Blend |  | 17.0 | 7.0 | 7.0 | 100% |
| Nu-Calgon Evap Foam | water | 7732-18-5 | 15.5 | 16 | 42.3 | 90% |
| 2-butoxyethanol | 111-76-2 | 16 | 5.1 | 12.3 | 5% |
| Diethylene glycol ethyl ether | 111-90-0 | 16.1 | 9.2 | 12.2 | 5% |
| Blend |  | 15.6 | 15.1 | 39.3 | 100% |
| CRC Foaming Coil Cleaner | water | 7732-18-5 | 15.5 | 16 | 42.3 | 95% |
| 2-butoxyethanol | 111-76-2 | 16 | 5.1 | 12.3 | 5% |
| Diethylene glycol ethyl ether | 111-90-0 | 16.1 | 9.2 | 12.2 | 0% |
| Blend |  | 15.5 | 15.5 | 40.8 | 100% |
| Nu-Calgon Evap Pow r C | water | 7732-18-5 | 15.5 | 16 | 42.3 | 85% |
| 2-butoxyethanol | 111-76-2 | 16 | 5.1 | 12.3 | 15% |
| Diethylene glycol ethyl ether | 111-90-0 | 16.1 | 9.2 | 12.2 | 0% |
| Blend |  | 15.6 | 14.4 | 37.8 | 100% |
| Nu-Calgon Blackhawk | water | 7732-18-5 | 15.5 | 16 | 42.3 | 90% |
| 2-butoxyethanol | 111-76-2 | 16 | 5.1 | 12.3 | 5% |
| Diethylene glycol ethyl ether | 111-90-0 | 16.1 | 9.2 | 12.2 | 5% |
| Blend |  | 15.6 | 15.1 | 39.3 | 100% |
| Sunshine Simple Green | water | 7732-18-5 | 15.5 | 16 | 42.3 | 70% |
| triethanolamine | 102-71-6 | 17.3 | 7.6 | 21 | 15% |
| Propylene Glycol Butyl Ether | 5131-66-8 | 15.3 | 4.5 | 9.2 | 5% |
| Ethoxylated Alcohol | 68439-46-3 | 15.8 | 4.9 | 7.7 | 10% |
| Blend |  | 15.8 | 13.1 | 34.0 | 100% |

Appendix C: Estimated Costs for Respirator PPE for 2023 TSCA Risk Management Economic Analyses

(See separate file)

November 2023

**Submitted to:**

**Economic and Policy Analysis Branch**

Existing Chemicals Risk Management Division

Office of Pollution, Prevention, and Toxics

U.S. Environmental Protection Agency

1200 Pennsylvania Avenue

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**Submitted by:**

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– Net Benefits Estimated Using a 2 Percent Discount Rate

This appendix presents the costs, benefits and net benefits using a 2 percent discount rate, as recommended in the recently revised Circular A-4. Circular No (see https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-4.pdf). A-4 provides the Office of Management and Budget’s (OMB’s) guidance to Federal agencies on the development of regulatory analysis as required under Section 6(a)(3)(C) of Executive Order 12866 of September 30, 1993 (Regulatory Planning and Review), as amended; the Regulatory Right-to-Know Act, Pub. L. 106–554, § 624, 114 Stat. 2763, 2763A–161 (2000) (codified as amended at 31 U.S.C. 1105 note); and a variety of related authorities.

Table D-1 and Table D-2 present the net benefits by use category estimated using a 2 percent discount rate using the low and high benefits estimates, respectively. Table D-3 summarizes the net benefits estimates estimated for 2, 3, and 7 percent discount rates.

Note that as discussed in Chapter 7, section 7.12, there are additional unquantified costs that affect all options. Similarly, Chapter 8 notes that there are also unquantified benefits. Therefore, it is not clear whether the monetized net benefits presented in the tables below under- or over-estimate the true social net benefits of the options.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table D-1: Total Annualized Net Benefits by Use Category and Option (Low Benefits Estimate, 2 Percent Discount Rate, 2022$) | | | | | | | | |
| Use Category | Costs | | Benefits | | | | Net Benefits | |
| Option 1  (Final Rule) | Option 2  (Alternative) | Option 1  (Final Rule) | | Option 2  (Alternative) | | Option 1  (Final Rule) | Option 2  (Alternative) |
| Manufacturing | $209,004 | $209,004 | $15 | | $15 | | ($208,989) | ($208,989) |
| Import/Repackage | $853,075 | $853,075 | $1,448 | | $1,448 | | ($851,627) | ($851,627) |
| Processing as a reactant | $647,389 | $647,389 | $2,098 | | $2,098 | | ($645,291) | ($645,291) |
| Waste Handling, Disposal, Treatment, and Recycling | $8,825,315 | $8,825,315 | $14,872 | | $14,872 | | ($8,810,443) | ($8,810,443) |
| Laboratory Use | $282,212 | $282,212 | $328 | | $328 | | ($281,884) | ($281,884) |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | $867,600 | $152,149,054 | $26,969 | | $27,005 | | ($840,631) | ($152,122,049) |
| Aerospace Paint and Coating Removers | $2,174,035 | $2,174,035 | $37,107 | | $37,130 | | ($2,136,928) | ($2,136,906) |
| Cellulose Triacetate Film Production | $12,512 | $12,512 | $384 | | $383 | | ($12,128) | ($12,129) |
| Furniture Refinishing | $16,453,389 | $16,453,389 | $179,183 | | $177,596 | | ($16,274,206) | ($16,275,793) |
| Glues, Sealants, Adhesives, and Caulks | $268,246 | $320,586 | $256,655 | | $568,107 | | ($11,592) | $247,520 |
| Vapor Degreasing | $3,822,875 | $3,822,875 | $1,849 | | $1,849 | | ($3,821,026) | ($3,821,026) |
| Liquid Cleaners and Degreasers | $51,709 | $51,709 | $271,817 | | $271,817 | | $220,108 | $220,108 |
| Aerosol Spray Cleaning/Degreasing | $971,265 | $971,265 | $1,495,849 | | $1,495,849 | | $524,584 | $524,584 |
| Paint and Coating Removers (graffiti Removal) | $768 | $768 | $21,439 | | $21,439 | | $20,671 | $20,671 |
| Paint and Coating Removers (Bathtub Refinishing) | $3,188 | $3,188 | $5,259,730 | | $5,259,730 | | $5,256,542 | $5,256,542 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | $45,133 | $45,133 | $82,648 | | $82,648 | | $37,516 | $37,516 |
| Paint and Coating Removers (Art Restoration) | $291 | $291 | $4 | | $4 | | ($287) | ($287) |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | $9,727 | $9,727 | $22,536 | | $22,536 | | $12,809 | $12,809 |
| Paint and Coating Removers (Professional Contracting) | $4,548 | $4,548 | $11,143,371 | | $11,143,371 | | $11,138,823 | $11,138,823 |
| Adhesive and Caulk Remover | $30,064 | $30,064 | $5,935,114 | | $5,935,114 | | $5,905,049 | $5,905,049 |
| Lithographic Printing Cleaner | $17,808 | $17,808 | $8,322 | | $8,322 | | ($9,486) | ($9,486) |
| Dry Cleaning and Spot Removers | $11,823 | $11,823 | $62,749 | | $62,749 | | $50,926 | $50,926 |
| Paint and Coatings | $511,160 | $511,160 | $8,812 | | $8,812 | | ($502,347) | ($502,347) |
| Lubricants and Greases | $131,100 | $131,100 | $1,090,591 | | $1,090,591 | | $959,491 | $959,491 |
| Cold Pipe Insulation | $59,402 | $59,402 | $899,506 | | $899,506 | | $840,103 | $840,103 |
| Anti-spatter Welding Aerosol | $94,971 | $94,971 | $264,372 | | $264,372 | | $169,401 | $169,401 |
| **Total** | **$36,358,610** | **$187,692,404** | **$27,087,768** | | **$27,397,691** | | **($9,270,841)** | **($160,294,712)** |
| Note: Costs and benefits for processors reformulating their methylene chloride products are accounted for under the use categories of the products being reformulated. | | | | | | | | |
| Table D-2: Total Annualized Net Benefits by Use Category and Option (High Benefits Estimate, 2 Percent Discount Rate, 2022$) | | | | | | | | |
| Use Category | Costs | | Benefits | | | Net Benefits | | |
| Option 1  (Final Rule) | Option 2  (Alternative) | Option 1  (Final Rule) | Option 2  (Alternative) | | Option 1  (Final Rule) | | Option 2  (Alternative) |
| Manufacturing | $209,004 | $209,004 | $15 | $15 | | ($208,988) | | ($208,988) |
| Import/Repackage | $853,075 | $853,075 | $1,464 | $1,464 | | ($851,612) | | ($851,612) |
| Processing as a reactant | $647,389 | $647,389 | $2,120 | $2,120 | | ($645,269) | | ($645,269) |
| Waste Handling, Disposal, Treatment, and Recycling | $8,825,315 | $8,825,315 | $15,029 | $15,029 | | ($8,810,286) | | ($8,810,286) |
| Laboratory Use | $282,212 | $282,212 | $332 | $332 | | ($281,880) | | ($281,880) |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | $867,600 | $152,149,054 | $27,290 | $27,253 | | ($840,310) | | ($152,121,801) |
| Aerospace Paint and Coating Removers | $2,174,035 | $2,174,035 | $37,521 | $37,498 | | ($2,136,514) | | ($2,136,537) |
| Cellulose Triacetate Film Production | $12,512 | $12,512 | $387 | $388 | | ($12,125) | | ($12,124) |
| Furniture Refinishing | $16,453,389 | $16,453,389 | $179,503 | $181,107 | | ($16,273,886) | | ($16,272,282) |
| Glues, Sealants, Adhesives, and Caulks | $268,246 | $320,586 | $574,096 | $259,360 | | $305,849 | | ($61,226) |
| Vapor Degreasing | $3,822,875 | $3,822,875 | $1,868 | $1,868 | | ($3,821,006) | | ($3,821,006) |
| Liquid Cleaners and Degreasers | $51,709 | $51,709 | $274,697 | $274,697 | | $222,988 | | $222,988 |
| Aerosol Spray Cleaning/Degreasing | $971,265 | $971,265 | $1,511,696 | $1,511,696 | | $540,431 | | $540,431 |
| Paint and Coating Removers (graffiti Removal) | $768 | $768 | $21,666 | $21,666 | | $20,898 | | $20,898 |
| Paint and Coating Removers (Bathtub Refinishing) | $3,188 | $3,188 | $5,260,046 | $5,260,046 | | $5,256,859 | | $5,256,859 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | $45,133 | $45,133 | $83,536 | $83,536 | | $38,403 | | $38,403 |
| Paint and Coating Removers (Art Restoration) | $291 | $291 | $4 | $4 | | ($287) | | ($287) |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | $9,727 | $9,727 | $22,774 | $22,774 | | $13,046 | | $13,046 |
| Paint and Coating Removers (Professional Contracting) | $4,548 | $4,548 | $11,144,041 | $11,144,041 | | $11,139,493 | | $11,139,493 |
| Adhesive and Caulk Remover | $30,064 | $30,064 | $5,997,681 | $5,997,681 | | $5,967,617 | | $5,967,617 |
| Lithographic Printing Cleaner | $17,808 | $17,808 | $8,410 | $8,410 | | ($9,398) | | ($9,398) |
| Dry Cleaning and Spot Removers | $11,823 | $11,823 | $63,410 | $63,410 | | $51,587 | | $51,587 |
| Paint and Coatings | $511,160 | $511,160 | $8,905 | $8,905 | | ($502,254) | | ($502,254) |
| Lubricants and Greases | $131,100 | $131,100 | $1,102,088 | $1,102,088 | | $970,988 | | $970,988 |
| Cold Pipe Insulation | $59,402 | $59,402 | $908,988 | $908,988 | | $849,586 | | $849,586 |
| Anti-spatter Welding Aerosol | $94,971 | $94,971 | $267,159 | $267,159 | | $172,188 | | $172,188 |
| **Total** | **$36,358,610** | **$187,692,404** | **$27,514,726** | **$27,201,536** | | **($8,843,883)** | | **($160,490,868)** |
| Note: Costs and benefits for processors reformulating their methylene chloride products are accounted for under the use categories of the products being reformulated. | | | | | | | | |

| Table D-3: Total Annualized Net Benefits by Option, (Millions, 2022$) | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Estimate | Costs | | Benefits | | Net Benefits | |
| Option 1  (Final Rule) | Option 2  (Alternative) | Option 1  (Final Rule) | Option 2  (Alternative) | Option 1  (Final Rule) | Option 2  (Alternative) |
| Low Benefits, 2 Percent Discount Rate | $36 | $188 | $27 | $27 | ($9.3) | ($160) |
| High Benefits, 2 Percent Discount Rate | $36 | $188 | $28 | $27 | ($9) | ($160) |
| Low Benefits, 3 Percent Discount Rate | $37 | $202 | $25 | $25 | ($12) | ($177) |
| High Benefits, 3 Percent Discount Rate | $37 | $202 | $25 | $25 | ($12) | ($178) |
| Low Benefits, 7 Percent Discount Rate | $39 | $267 | $20 | $20 | ($20) | ($247) |
| High Benefits, 7 Percent Discount Rate | $39 | $267 | $20 | $20 | ($19) | ($247) |

– Benefits and Net Benefits Estimated Using the Lowering Factor

This appendix presents a sensitivity analysis for the low benefits estimate using a “lowering factor” adjustment to the excess lifetime risk for cancer. The lowering factor is an adjustment to the excess lifetime risk for cancer to account for the shorter exposure durations being considered and the life stage at which the changes in exposure occur. The excess lifetime risk for cancer is usually defined as an increase in cancer risk over a lifetime of exposure. However, a new policy may affect only a shorter duration of exposure, and that effect can occur at different stages of exposed individuals’ lives.

The lowering factor is calculated as the percentage of incidence of the cancer that occurs within the age range spanning from the age at which the change in exposure is experienced through the end of the expected lifetime. For example, if 85 percent of cancer cases occur in individuals aged 50 or older, the lowering factor for an individual experiencing a one-year change in exposure at age 50 is 85%. As noted in EPA ([2013](#_ENREF_85)), “For example, consider someone who is 50 years old in the year of the analysis and has not yet gotten the cancer. Should the entire excess lifetime risk (the unit risk) be applied to this individual for the remaining expected years of his life? Or should a modified excess risk, conditional on his not having gotten the cancer in his first 49 years, be applied? Because the unit risk provides no information about how excess risk is distributed over the course of a lifetime, there is no clear answer.” Thus, the lowering factors presented in Table E-1 are used in estimating the low estimate for the value of the risk reductions.

|  |  |  |
| --- | --- | --- |
| Table E-1: Lowering Factors, by Sector and Cancer Site | | |
| Affected Population Sector | Cancer Site | Lowering Factor |
| Manufacturing | C34.9-Lung, NOS | 95% |
| Liver | 91% |
| Construction | C34.9-Lung, NOS | 95% |
| Liver | 92% |
| Transportation and Public Utilities | C34.9-Lung, NOS | 95% |
| Liver | 91% |
| Services | C34.9-Lung, NOS | 94% |
| Liver | 90% |
| Source: Abt Associates 2023b | | |

Including the lowering factor affects the estimated distribution for the lag between exposure and diagnosis and exposure and mortality (for cancer that is ultimately fatal). Table E-2 presents the estimated values for microrisk reductions that are estimated using the lowering factor.

| Table E-2: Value for Microrisk Reductions Estimated Using Lowering Factor (2022$) | | | |
| --- | --- | --- | --- |
| Affected Population Sector | Cancer Site | Estimated Value for a 1/1,000,000 Reduction in Cancer Risk | |
| Low Estimate (with lowering factor) | |
| 7% | 3% |
| Manufacturing | C34.9-Lung, NOS | $2.78 | $6.01 |
| Liver | $2.83 | $5.86 |
| Construction | C34.9-Lung, NOS | $2.70 | $5.95 |
| Liver | $2.77 | $5.82 |
| Services | C34.9-Lung, NOS | $2.67 | $5.83 |
| Liver | $2.65 | $5.63 |
| Transportation and public Utilities | C34.9-Lung, NOS | $2.77 | $5.99 |
| Liver | $2.81 | $5.84 |
| Source: Abt Associates 2023b | | | |

Table E-3 presents the estimated 3 and 7 percent annualized benefits using the lower WTP value for non-fatal liver cancer and the lowering factor. Table E-4 presents the net annualized benefits using the lower WTP value for non-fatal liver cancer with and without the lowering factor.

| Table E-3: Total Monetized Benefits by Use Category and Option (20-Year Annualized using Lowering Factor and Low Benefits Estimate, 2022$) | | | | |
| --- | --- | --- | --- | --- |
| Use Category | 3 Percent Discount Rate | | 7 Percent Discount Rate | |
| Option 1  (Final Rule) | Option 2  (Alternative) | Option 1  (Final Rule) | Option 2  (Alternative) |
| Manufacturing | $11 | $11 | $5 | $5 |
| Import/Repackage | $1,057 | $1,057 | $482 | $482 |
| Processing as a reactant | $1,531 | $1,531 | $698 | $698 |
| Incorporation Into Formulation, Mixture, or Reaction Product | $2,834 | $2,834 | $1,292 | $1,292 |
| Waste Handling, Disposal, Treatment, and Recycling | $10,851 | $10,851 | $4,946 | $4,946 |
| Laboratory Use | $240 | $240 | $109 | $109 |
| Processing Aid, Plastics Manufacturing, and Solvent Welding | $19,677 | $19,703 | $8,969 | $8,981 |
| Aerospace Paint and Coating Removers | $27,072 | $27,087 | $12,340 | $12,346 |
| Cellulose Triacetate Film Production | $280 | $279 | $128 | $127 |
| Furniture Refinishing | $127,549 | $126,523 | $57,244 | $56,973 |
| Glues, Sealants, Adhesives, and Caulks | $176,478 | $413,650 | $63,548 | $188,556 |
| Vapor Degreasing | $1,344 | $1,344 | $612 | $612 |
| Liquid Cleaners and Degreasers | $198,141 | $198,141 | $88,710 | $88,710 |
| Aerosol Spray Cleaning/Degreasing | $1,090,497 | $1,090,497 | $488,229 | $488,229 |
| Paint and Coating Removers (Graffiti Removal) | $15,630 | $15,630 | $6,998 | $6,998 |
| Paint and Coating Removers (Bathtub Refinishing) | $5,222,781 | $5,222,781 | $5,079,293 | $5,079,293 |
| Paint and Coating Removers (Automotive Repair and Refinishing) | $58,835 | $58,835 | $26,449 | $26,449 |
| Paint and Coating Removers (Art Restoration) | $3 | $3 | $1 | $1 |
| Paint and Coating Removers (Pleasure Craft Building and Repairing) | $16,435 | $16,435 | $7,492 | $7,492 |
| Paint and Coating Removers (Professional Contracting) | $11,065,091 | $11,065,091 | $10,761,094 | $10,761,094 |
| Adhesive and Caulk Remover | $4,330,262 | $4,330,262 | $1,973,884 | $1,973,884 |
| Lithographic Printing Cleaner | $6,025 | $6,025 | $2,746 | $2,746 |
| Dry Cleaning and Spot Removers | $45,770 | $45,770 | $20,864 | $20,864 |
| Paint and Coatings | $4,989 | $4,989 | $2,274 | $2,274 |
| Lubricants and Greases | $795,630 | $795,630 | $362,676 | $362,676 |
| Cold Pipe Insulation | $656,272 | $656,272 | $299,151 | $299,151 |
| Anti-spatter Welding Aerosol | $192,711 | $192,711 | $87,845 | $87,845 |
| **Total** | **$24,067,992** | **$24,304,179** | **$19,358,079** | **$19,482,834** |

| Table E-4: Total 20-Year Annualized Net Benefits Using Low Benefits Estimates With and Without Lowering Factor by Option, (Millions, 2022$) | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Estimate | Costs | | Benefits | | Net Benefits | |
| Option 1  (Final Rule) | Option 2  (Alternative) | Option 1  (Final Rule) | Option 2  (Alternative) | Option 1  (Final Rule) | Option 2  (Alternative) |
| With Lowering Factor 3 Percent Discount Rate | $37 | $202 | $24 | $24 | ($13) | ($178) |
| Without Lowering Factor 3 Percent Discount Rate | $37 | $202 | $25 | $25 | ($12) | ($177) |
| With Lowering Factor 7 Percent Discount Rate | $39 | $267 | $19 | $19 | ($20) | ($247) |
| Without Lowering Factor 7 Percent Discount Rate | $39 | $267 | $20 | $20 | ($20) | ($247) |

1. See Table 8‑3 for a map between the use categories and the applicable occupational exposure scenarios (OES) from the risk evaluation. [↑](#footnote-ref-3)
2. https://www.epa.gov/sites/default/files/2016-06/documents/ejtg\_5\_6\_16\_v5.1.pdf [↑](#footnote-ref-4)
3. See Table 8‑3 for a map between the use categories and the applicable occupational exposure scenarios (OES) from the risk evaluation. [↑](#footnote-ref-5)
4. See https://dtsc.ca.gov/scp/priority-products/. [↑](#footnote-ref-6)
5. The Kaldor-Hicks criterion is also referred to as the potential Pareto criterion or the potential compensation principle because it implies that economic efficiency is improved if those who benefit from an action could fully compensate the those who lose from that action, and still be better off. In other words, it is theoretically possible to achieve a Pareto improvement – in which some are made better off, and no one is made worse off – if those who benefit from a regulation were to fully compensate those who pay the cost. The word “potential” is used because the compensation does not have to actually occur, it just has to be theoretically possible to do so for this to be a social improvement. [↑](#footnote-ref-7)
6. This discussion focuses on negative externalities because this is the market failure addressed by this proposed regulation. Please refer to *EPA Guidelines for Preparing Economic Analyses* ([EPA 2014a](#_ENREF_86)) for a discussion on additional sources of market failure identified in the literature. [↑](#footnote-ref-8)
7. Under EPA regulations, a chemical is VOC-exempt, if it: (1) has vapor pressure of less than 0.1 millimeters of mercury (at 20 degrees Celsius); Or, (2) if the vapor pressure is unknown: (a) Consists of more than 12 carbon atoms; or (b) Has a melting point higher than 20 degrees C and does not sublime (*i.e.*, does not change directly from a solid into a gas without melting). [↑](#footnote-ref-9)
8. GreenScreen for Safer Chemicals is a method for chemical hazard assessment designed to identify chemicals of high concern and safer alternatives. Each chemical evaluated under GreenScreen is assigned a Benchmark between 1 and 4, with each increasing Benchmark defining progressively safer chemicals. See [GreenScreen® Method | GreenScreen® For Safer Chemicals (greenscreenchemicals.org)](https://www.greenscreenchemicals.org/learn/full-greenscreen-method), https://www.greenscreenchemicals.org/learn/full-greenscreen-method. [↑](#footnote-ref-10)
9. GreenScreen for Safer Chemicals is a method for chemical hazard assessment designed to identify chemicals of high concern and safer alternatives. Each chemical evaluated under GreenScreen is assigned a Benchmark between 1 and 4, with each increasing Benchmark defining progressively safer chemicals. See [GreenScreen® Method | GreenScreen® For Safer Chemicals (greenscreenchemicals.org)](https://www.greenscreenchemicals.org/learn/full-greenscreen-method), https://www.greenscreenchemicals.org/learn/full-greenscreen-method. [↑](#footnote-ref-11)
10. GreenScreen for Safer Chemicals is a method for chemical hazard assessment designed to identify chemicals of high concern and safer alternatives. Each chemical evaluated under GreenScreen is assigned a Benchmark between 1 and 4, with each increasing Benchmark defining progressively safer chemicals. See [GreenScreen® Method | GreenScreen® For Safer Chemicals (greenscreenchemicals.org)](https://www.greenscreenchemicals.org/learn/full-greenscreen-method), https://www.greenscreenchemicals.org/learn/full-greenscreen-method. [↑](#footnote-ref-12)
11. GreenScreen for Safer Chemicals is a method for chemical hazard assessment designed to identify chemicals of high concern and safer alternatives. Each chemical evaluated under GreenScreen is assigned a Benchmark between 1 and 4, with each increasing Benchmark defining progressively safer chemicals. See [GreenScreen® Method | GreenScreen® For Safer Chemicals (greenscreenchemicals.org)](https://www.greenscreenchemicals.org/learn/full-greenscreen-method), https://www.greenscreenchemicals.org/learn/full-greenscreen-method. [↑](#footnote-ref-13)
12. GreenScreen for Safer Chemicals is a method for chemical hazard assessment designed to identify chemicals of high concern and safer alternatives. Each chemical evaluated under GreenScreen is assigned a Benchmark between 1 and 4, with each increasing Benchmark defining progressively safer chemicals. See [GreenScreen® Method | GreenScreen® For Safer Chemicals (greenscreenchemicals.org)](https://www.greenscreenchemicals.org/learn/full-greenscreen-method), https://www.greenscreenchemicals.org/learn/full-greenscreen-method. [↑](#footnote-ref-14)
13. GreenScreen for Safer Chemicals is a method for chemical hazard assessment designed to identify chemicals of high concern and safer alternatives. Each chemical evaluated under GreenScreen is assigned a Benchmark between 1 and 4, with each increasing Benchmark defining progressively safer chemicals. See [GreenScreen® Method | GreenScreen® For Safer Chemicals (greenscreenchemicals.org)](https://www.greenscreenchemicals.org/learn/full-greenscreen-method), https://www.greenscreenchemicals.org/learn/full-greenscreen-method. [↑](#footnote-ref-15)
14. By applying the speciation factors directly to input solvent volume to estimate pollutant emissions, NEI implicitly assumes that 100 percent of the solvents are emitted to the air. Thus, by this assumption, the make-up of solvent emissions would mirror the make-up of the solvent input. [↑](#footnote-ref-16)
15. The consumer price index increased by 123.91 percent between 1990 and 2022, so $4.8 million (1990$) is converted to $10.75 million (2022$) after adjusting for inflation. GDP per capita increased by 60.16 percent between 1990 and 2022, and this analysis uses EPA’s ([2014a](#_ENREF_86)) recommended income elasticity of 0.4 to calculate the income adjustment factor of 1.20732 (=1.6016^0.4). Thus, the $10.75 million (2022$) is adjusted for income growth using an adjustment factor of 1.20732, and the resulting estimate is $12.98 million. [↑](#footnote-ref-17)
16. Measured concentrations of various contaminants are very often found to have frequency distributions that are log-normal, including indoor-air contaminants ([Ott 1990](#_ENREF_55)). [Ott (1990)](#_ENREF_55) also provides a physical explanation for why some common processes in nature, including processes relevant to indoor air pollutant concentrations, can explain why lognormal distributions arise naturally. Therefore, EPA believes assuming exposure levels follow a log-normal distribution is a reasonable approach. [↑](#footnote-ref-18)
17. The only SAR that would have an APF rating of 10 would be the combination of a demand mode respirator with a half mask. EPA conducted a search for available respirators and no SARs that operate in demand mode were identified. [↑](#footnote-ref-19)
18. Because metabolites of methylene chloride produced by the GST pathway are primarily responsible for methylene chloride carcinogenicity in mouse liver and lungs and based on the assumption that metabolites are reactive enough that they don’t have substantial distribution outside the liver, the internal tissue-dose metrics used were daily mass of methylene chloride metabolized via the GST pathway per unit volume of liver and lung, respectively. When lung and liver tumors were combined to calculate BMDs and BMDLs for a holistic combination of tumors, a whole-body GST metric was used that essentially combined the lung and liver internal doses. [↑](#footnote-ref-20)
19. The consumer price index increased by 123.91 percent between 1990 and 2022, so $4.8 million (1990$) is converted to $10.75 million (2022$) after adjusting for inflation. GDP per capita increased by 60.16 percent between 1990 and 2022, and this analysis uses EPA’s ([2014a](#_ENREF_86)) recommended income elasticity of 0.4 to calculate the income adjustment factor of 1.20732 (=1.6016^0.4). Thus, the $10.75 million (2022$) is adjusted for income growth using an adjustment factor of 1.20732, and the resulting estimate is $12.98 million. [↑](#footnote-ref-21)
20. Dun and Bradstreet data collected for the proposed rule economic analysis are used for entities that could not be identified in the Experian data. [↑](#footnote-ref-22)
21. [Dun & Bradstreet (2022)](#_ENREF_17) data on numbers of employees and revenues were used when entities could not be identified in the Experian data. [↑](#footnote-ref-23)
22. [Dun & Bradstreet (2022)](#_ENREF_17) data on numbers of employees and revenues were used when entities could not be identified in the Experian data. [↑](#footnote-ref-24)
23. https://www.epa.gov/sites/default/files/2016-06/documents/ejtg\_5\_6\_16\_v5.1.pdf [↑](#footnote-ref-25)
24. As identified in EPA’s Fenceline memo for Methylene Chloride [↑](#footnote-ref-26)
25. NAICS codes beginning with 325 (Chemicals) as well as 424690 (Other Chemical and Allied Products Merchant Wholesalers), and 541712 (Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)) [↑](#footnote-ref-27)
26. This analysis uses 5-year American Community Survey (ACS) data from 2015-2019 retrieved from IPUMS ([Manson, Schroeder et al. 2021](#_ENREF_38)). The data include approximately 16 million individual ACS responses. The geographic resolution of the data is the Public Use Microdata Area (PUMA) districts defined by the United States Census Bureau. PUMAs are the smallest geographic unit for which detailed individual Census data, including employment and industry information, are available. PUMA districts include roughly 100,000-200,000 people with an average of about 140,000 people. The average spatial area of a PUMA is 1,692 square miles. Thus, the spatial resolution of this analysis is much coarser than the community profile information reported above reflecting populations within 1 and 3 miles of each facility. PUMAs are useful as a broad representation of the labor market from which workers may be drawn, but EPA lacks information on how close workers tend to live to their workplaces across these different industries and locations. While Census provides a “person weight” that indicates how many persons in the U.S. population a sampled individual represents in terms of sex, race, ethnicity, and other characteristics, this analysis present unweighted summary statistics because of the focus on specific industries that are not accounted for by the person weights. [↑](#footnote-ref-28)
27. Available at https://www.epa.gov/rsei/rsei-geographic-microdata-rsei-gm. [↑](#footnote-ref-29)
28. Note that 1 ppm pf methylene chloride is equivalent to 356 . [↑](#footnote-ref-30)