

Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives - Revised

PREPARED FOR:

Stratospheric Protection Division
Office of Air and Radiation
U.S. Environmental Protection Agency
Washington, D.C. 20460

PREPARED BY:

ICF International
1725 Eye Street, NW
Washington, DC 20006

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Executive Summary

The Significant New Alternatives Policy (SNAP) Program is the U.S. Environmental Protection Agency's (EPA) program to evaluate and regulate substitutes under the Clean Air Act (CAA). In Section 612(c) of the CAA, the Agency is authorized to identify and publish lists of acceptable and unacceptable substitutes.

EPA is changing the listing status of certain high-GWP alternatives used in aerosols, foams, commercial refrigeration, and motor vehicle air conditioning (MVAC). The final regulatory changes are summarized in Exhibit ES-1. To assist the Agency in satisfying its obligations under the Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA), this report provides a screening analysis to assess the potential economic impacts on small entities associated with these changes.

Industries potentially affected by these regulatory options were primarily identified by North American Industry Classification System (NAICS) codes. Small businesses in each affected industry were classified as such based on size definitions established by the Small Business Administration. Economic impacts on affected small businesses were calculated using a direct compliance cost method. The “sales test” was applied by estimating annualized compliance costs for affected small businesses as a percentage of those businesses’ annual sales.

This screening analysis finds that the rulemaking can be presumed to have ***no significant economic impact on a substantial number of small entities (SISNOSE)***.

This screening analysis finds that this rulemaking can be presumed to have no SISNOSE for the following reasons:

- About 500,000 small businesses could be subject to the rulemaking, although more than 99% of small businesses subject to this rulemaking would be expected to experience zero compliance costs.

Exhibit ES-1: Summary of Regulatory Changes Analyzed

- List unacceptable HFC-134a for new MVACs starting in model year 2021; narrowed use limits apply for export to countries without servicing infrastructure through model year 2025.
- List unacceptable HFC-125 for aerosols in 2016, restrict use of HFC-134a to certain medical aerosols and technical aerosols in 2018 and one year from date of publication; restrict use of HFC-227ea and blends of HFC-227ea and HFC-134a to metered dose inhalers in aerosols one year from date of publication.
- List unacceptable certain HFCs and HFC blends in 1) rigid polyurethane appliance foam; 2) flexible polyurethane; 3) rigid polyurethane: commercial refrigeration and sandwich; 4) rigid polyurethane and polyisocyanurate laminated boardstock; 5) rigid polyurethane slabstock; 6) polyurethane integral skin; 7) polystyrene: extruded sheet; 8) polystyrene: extruded boardstock and billet; 9) polyolefin; 10) PU marine flotation foam and 11) phenolic foams in various years from 2017 to 2021 for specified end-uses, except for certain military, space- and aeronautics- related applications.

Commercial Refrigeration:

- List unacceptable 10 high-GWP HFCs/HFC blends for: new supermarket systems in 2017; new remote condensing units in 2018.
- List unacceptable 9 high-GWP HFC blends for: retrofitted supermarket systems and retrofitted remote condensing units one year from date of publication.
- List unacceptable 31 high-GWP HFCs/HFC blends for: new stand-alone medium-temperature units with a compressor capacity below 2,200 Btu/hr and not containing a flooded evaporator in 2019 and all other new stand-alone medium-temperature units in 2020.
- List unacceptable 28 high-GWP HFCs/HFC blends for new stand-alone low-temperature units in 2020.
- List unacceptable R-404A and R-507A for retrofitted stand-alone retail food refrigeration equipment one year from date of publication.
- List unacceptable 20 high-GWP HFCs/HFC blends for new vending machines in 2019.
- List unacceptable R-404A and R-507A for retrofitted vending machines one year from date of publication.

- For about 120 small businesses that are expected to incur compliance costs as a result of this rulemaking, their costs are estimated to be less than 1% of annual sales.
- This analysis indicates that fewer than 80 of the nearly 500,000 affected small businesses—or <0.1%—could incur costs in excess of 1% of annual sales, and that fewer than 60 small businesses could incur costs in excess of 3% of annual sales.

Total annualized compliance costs across affected small businesses are estimated at approximately \$4.5-\$7.7 million at a 7% discount rate, or \$2.3-\$4.7 million at a 3% discount rate. The aggregated economic impacts on small businesses and SISNOSE determination are summarized in Table ES-1. Affected small businesses are manufacturers of light-duty vehicles and trucks, consumer and some technical and medical aerosol products, domestic and commercial refrigerated appliances, polyurethane foams, polystyrene foams, polyolefin foams, polyisocyanurate foams, and self-contained retail food equipment and vending machines.

Table ES-1: Aggregated Economic Impacts on Small Businesses and SISNOSE Determination

Economic Impact	Number of Small Entities Subject to the Rule and Experiencing Given Economic Impact	Percent of All Small Entities Subject to the Rule That are Experiencing Given Economic Impact
Less than 1% for all affected small entities ^a	120	0.02%
1% or more for one or more affected small entities ^b	74	0.01%
Greater than 3% for one or more affected small entities	57	0.01%

^a Represents small entities affected with an economic impact equal to or lesser than 1% but greater than 0%.

^b This category aggregates the number of small entities that would be expected to experience an impact of 1% to 3% with the number of small entities that would be expected to experience an impact of 3% or greater.

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1 Introduction

The Significant New Alternatives Policy (SNAP) Program is the U.S. Environmental Protection Agency's (EPA) program to evaluate and regulate substitutes under the Clean Air Act (CAA). In CAA Section 612(c), the Agency is authorized to identify and publish lists of acceptable and unacceptable substitutes.

EPA is changing the listing status of certain high-GWP alternatives used in aerosols, foams, commercial refrigeration, and motor vehicle air conditioning (MVAC). The regulatory changes are shown in Table 1. To assist the Agency in satisfying its obligations under the Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA),¹ this report provides a screening analysis to assess the potential economic impacts on small entities associated with these changes. This analysis finds that the final rulemaking can be presumed to have ***no significant economic impact on a substantial number of small entities (SISNOSE)***.

Table 1: Unacceptable Substitutes and Substitutes Subject to Use Restrictions

Sector	Description of Regulatory Change
MVACs	List unacceptable HFC-134a for new MVACs starting in model year 2021; narrowed use limits apply for export to countries without servicing infrastructure through model year 2025.
Aerosols	List unacceptable HFC-125 for aerosols in 2016, restrict use of HFC-134a to certain medical aerosols and technical aerosols in 2018 and one year from date of publication; restrict use of HFC-227ea and blends to metered dose inhalers in aerosols one year from date of publication.
Foams	List unacceptable HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof, Formacel TI, and Formacel Z-6 in rigid polyurethane (PU) appliance foam, rigid PU commercial refrigeration and sandwich panels, polyolefin, and PU marine floatation foam in 2020.
	List unacceptable HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, and Formacel Z-6 in rigid PU slabstock and other in 2019.
	List unacceptable HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; in rigid PU and polyisocyanurate laminated boardstock and in flexible PU in 2017.
	List unacceptable HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, and Formacel Z-6 in integral skin PU and in polystyrene extruded sheet in 2017.
	List unacceptable HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel B, Formacel TI, and Formacel Z-6 in polystyrene extruded boardstock and billet (XPS) in 2021.
	List unacceptable HFC-143a, HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; in phenolic insulation board and bunstock in 2017.
Commercial Refrigeration	List unacceptable 10 high-GWP HFCs/HFC blends (R-404A, R-407B, R-421B, R-422A, R-422C, R-422D, R-428A, R-434A, R-507A, and HFC-227ea) for new supermarket systems in 2017.
Commercial Refrigeration	List unacceptable 9 high-GWP HFC blends (R-404A, R-407B, R-421B, R-422A, R-422C, R-422D, R-428A, R-434A, and R-507A,) for retrofitted supermarket systems one year from date of publication.
	List unacceptable 10 high-GWP HFCs/HFC blends (R-404A, R-407B, R-421B, R-422A, R-422C, R-422D, R-428A, R-434A, R-507A, and HFC-227ea) for new remote condensing units in 2018.

¹ For all rules subject to the RFA, a screening analysis is required to first determine what, if any, impact a rulemaking may have on small entities. For rules that pose "a significant economic impact on a substantial number of small entities," an initial and final regulatory flexibility analysis is further required.

Sector	Description of Regulatory Change
	List unacceptable 9 high-GWP HFC blends (R-404A, R-407B, R-421B, R-422A, R-422C, R-422D, R-428A, R-434A, and R-507A, and R-227ea) for retrofitted remote condensing units one year from date of publication.
	List unacceptable 20 high-GWP HFCs/HFC blends (FOR12A, FOR12B, HFC-134a, KDD6, R-125/290/134a/600a (55/1/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-426A, R-437A, R-438A, R-507A, RS-24 (2002 formulation), and SP34E) for new vending machines in 2019.
	List unacceptable R-404A and R-507A for retrofitted vending machines one year from date of publication.
	List unacceptable 31 high-GWP HFCs/HFC blends (FOR12A, FOR12B, HFC-134a, HFC-227ea, KDD6, R-125/290/134a/600a (55/1/42.5/1.5), R-404A, R-407A, R-407B, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-424A, R-426A, R-428A, R-434A, R-437A, R-438A, R-507A, RS-24 (2002 formulation), RS-44 (2003 formulation), SP34E, and THR-03) for new stand-alone medium-temperature units with a compressor capacity below 2,200 Btu/hr and not containing a flooded evaporator in 2019.
	List unacceptable 31 high-GWP HFCs/HFC blends (FOR12A, FOR12B, HFC-134a, HFC-227ea, KDD6, R-125/290/134a/600a (55/1/42.5/1.5), R-404A, R-407A, R-407B, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-424A, R-426A, R-428A, R-434A, R-437A, R-438A, R-507A, RS-24 (2002 formulation), RS-44 (2003 formulation), SP34E, and THR-03) for new stand-alone medium-temperature units with a compressor capacity equal to or greater than 2,200 Btu/hr and all new stand-alone medium-temperature units not containing a flooded evaporator in 2020.
	List unacceptable 24 high-GWP HFCs/HFC blends (HFC-227ea, KDD6, R-125/290/134a/600a (55/1/42.5/1.5), R-404A, R-407A, R-407B, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R-424A, R-428A, R-434A, R-437A, R-438A, R-507A, and RS-44 (2003 formulation)) for new stand-alone low-temperature units in 2020.
	List unacceptable R-404A and R-507A for retrofitted stand-alone retail food refrigeration equipment one year from date of publication.

The remainder of this report is organized as follows:

- **Chapter 2** presents the general approach and assumptions used to ensure consistency across the analysis, and also summarizes key assumptions made for each of the four affected industries.
- **Chapters 3, 4, 5, and 6** identify the small entities potentially affected by the regulatory changes and then estimate the economic impact on those affected entities, for the MVAC, aerosols, foams, and commercial refrigeration industries, respectively.
- **Chapter 7** summarizes the aggregate small business impacts of the regulatory changes, along with a recommendation for certification based on a decision matrix for determining SISNOSE.

2 Summary of General Approach and Key Analytical Assumptions

To ensure consistency across the analysis, standard analytical steps and approaches were followed for each of the affected industries, as shown in Table 2.

Table 2: General Steps and Approach for Small Business Impact Analyses

Step	Approach
Identify the types of industries expected to be directly impacted by the regulatory changes	<p>For all sectors, potentially affected industries were identified by North American Industry Classification System (NAICS) codes. Economic data about each affected industry—including number of firms and establishments² by employment or receipts size—was obtained from the U.S. Census Bureau’s Industry Statistics Portal (http://www.census.gov/econ/isp/) and includes data from the 2007 Economic Census. The economic census profiles U.S. national and local economies every five years, and the 2007 data is the latest available at the time of this writing.</p> <p>By change the listing status of certain high-GWP alternatives used in aerosols, foams, commercial refrigeration, and MVAC, this rulemaking potentially directly impacts small entities associated with these changes. Other entities may experience indirect effects as a result of market changes influenced by the rule, but these are not to be considered in this analysis. See <i>Cement Kiln Recycling Coalition v. EPA</i>, 255 F.3d 855, 869 (D.C. Cir. 2001) (the D.C. Circuit “has consistently rejected the contention that the RFA applies to small businesses indirectly affected by the regulation of other entities.”).</p> <p>This rule’s provisions do not create enforceable requirements for refrigeration and air conditioning technicians, but they would indirectly affect technicians servicing MVAC systems, retail food refrigeration equipment, and vending machines where the technician, rather than the refrigeration or AC equipment owner, purchases servicing equipment for different refrigerants. EPA expects these indirect impacts on technicians are minimal, because the transitions to different refrigerants required by this rule are already occurring due to other regulations (e.g., light duty vehicle GHG rule) and corporate social responsibility initiatives (e.g., Consumer Goods Forum pledge concerning HFC refrigerants), and because many of the still-acceptable alternatives are already used for these refrigeration or air conditioning equipment types. Further, most acceptable HFC refrigerant blends can be recovered and serviced using equipment that service technicians already own.</p>
Determine what proportion of impacted industries are small businesses	<p>For all industries, small businesses were identified using the U.S. Small Business Administration’s table of small business size standards matched to NAICS codes. The version employed for this analysis became effective July 22, 2013.</p> <p>In several industries, the small business threshold was defined as a <i>firm</i> with fewer than a certain number of employees, but Census data was only available by</p>

² The U.S. Census Bureau defines an establishment as a single physical location where business is conducted or where services or industrial operations are performed; a firm is a business organization consisting of one or more domestic establishments in the same state and industry that were specified under common ownership or control. The firm and the establishment are the same for single-establishment firms. For each multi-establishment firm, establishments in the same industry within a state are counted as one firm, and the firm employment and annual payroll are summed from the associated establishments.

Step	Approach
	<i>establishment</i> size. In these cases, the threshold was applied to <i>establishment</i> sizes. This is considered a conservative proxy, as the number of establishments is typically greater than, and can be no lower than, the number of firms by definition.
Determine what proportion of small businesses could be directly impacted	This determination was made on an individual sector and end-use basis, taking into consideration whether the HFCs affected by this rulemaking are still—or were ever—known to be in use, and what proportion of the market the affected HFCs are expected to represent at the time that the regulations would come into effect.
For the purposes of quantifying compliance costs, make assumptions about the alternative refrigerants, foam blowing agents, and aerosols that would likely be used in place of the HFCs affected by this rulemaking	For the purposes of quantifying compliance costs, this analysis has made some assumptions regarding which alternatives are implemented in the transition away from the HFCs affected by this rulemaking. These assumptions are not intended to represent the range of available alternatives, or to imply that other alternatives are not available. For a fuller accounting of substitutes, please refer to the lists of acceptable substitutes as published under EPA’s SNAP Program (www.epa.gov/ozone/snap/). For the purposes of this analysis, the assumption about the alternative modeled was made on an individual sector or end-use basis, relying primarily on assumptions in EPA’s Vintaging Model (EPA 2012), EPA’s report on <i>Global Mitigation of Non-CO₂ Greenhouse Gases: 2010-2030</i> (EPA 2013), and lists of acceptable substitutes under SNAP.
Quantify the economic impact on small businesses	<p>This analysis uses the direct compliance cost method to quantify impacts. Direct compliance costs include capital, operating, maintenance, and other direct compliance costs associated with switching to alternatives as a result of the regulatory changes. These costs were annualized to calculate a metric that can be compared with annual sales in the next step of the analysis.³</p> <p>Consistent with EPA’s <i>Guidelines for Preparing Economic Analysis</i> (2010), capital costs were annualized over the expected lifetime of the capital equipment using the opportunity cost of capital (discount rate). This screening analysis uses a 3 percent and 7 percent discount rate, in line with OMB Circular A-94, which provides guidelines for discount rates in benefit-cost analyses of federal programs. Where applicable, annual non-capital compliance costs—such as ongoing operating and maintenance costs—are added to the annualized capital costs to yield a total annualized cost of compliance.</p> <p>All costs and savings values are expressed in constant year 2013 U.S. dollars, adjusted using the implicit GDP price deflator published by the U.S. Bureau of Economic Analysis.</p> <p>When available and appropriate, cost assumptions identified in EPA’s report on <i>Global Mitigation of Non-CO₂ Greenhouse Gases: 2010-2030</i> (EPA 2013) and information from comments or other industry input were employed. For sub-sectors for which these cost data were not estimated, other available sources were sought, as described in the individual sector chapters. It should be noted that all cost information reflects the current cost of compliance, and thus likely represents a higher-end estimate of the cost of compliance in the years in which the</p>

³ In some industries, an upfront capital expenditure is involved with complying with the regulatory actions. As an example, some manufacturers of refrigerated vending machines may purchase new equipment costing \$100,000 to switch from HFCs to carbon dioxide. Annualizing this upfront cost provides a metric that can be compared with annual revenues, and reflects an expectation that such upfront capital expenditures might be financed.

Step	Approach
	regulatory changes would become effective (i.e., 2016 and beyond). For example, the price of alternative refrigerants and blowing agents would likely be expected to decrease over time.
Perform the sales test	<p>For this analysis, the “sales test” was applied, which calculates annualized compliance costs as a percentage of annual sales. For industries for which annual sales data was not available through the Economic Census, annual receipts or annual value of shipments⁴ was utilized as a reasonable proxy.</p> <p>For the purposes of the sales test, annualized compliance costs were calculated using a 7% discount rate.</p> <p>Applying this sales test resulted in several possible outcomes apart from a positive percentage (such as 1% or 3%). In some cases, no small entities would be expected to be impacted by the rulemaking in a given NAICS code. In these instances, the result is shown as Not Applicable (NA). In other cases, the annualized cost of compliance was expected to be zero because the cost of using alternative refrigerants or blowing agents was negligible (i.e. zero dollars). In these instances, the result is shown as 0%. In some other cases, the annualized cost was found to be negative (i.e. cost-saving) because the annual cost savings associated with a lower-cost alternative outweighed the annualized value of the upfront capital expenditure. In these instances, the result is shown as <0%.</p>

Chapters 3, 4, 5, and 6 that follow further describe the specific data and assumptions that enable the estimation of the economic impact on small businesses in the industries potentially affected by this rulemaking. Table 3 summarizes some of these key assumptions by industry and end-use—including which HFCs are currently assumed to be in use in each end-use, and to which alternatives each end-use is assumed to transition—for the purposes of estimating costs. Table 3 also summarizes the types of entities expected to be directly impacted.

⁴ Total value of shipments includes the received or receivable net selling values of all products shipped (exclusive of freight and taxes).

Table 3: Assumptions Concerning Types of HFCs in Use, Alternatives Modeled, and Types of Entities Affected

Sector	End Use		Primary HFC(s) Assumed to be Currently in Use	Alternatives Modeled for the Cost Analysis*	Types of Entities Directly Affected
MVAC	Motor Vehicle Air Conditioning		HFC-134a	HFO-1234yf	Automobile manufacturers
Aerosols	Propellants		HFC-134a in tire inflators and products for functional testing of smoke detectors; majority of remaining HFC use is in excepted uses;	Hydrocarbons (HC) and HFO-1234ze	Manufacturers of aerosol products, including consumer, technical, and medical aerosols
Foam	Rigid PU: (household) appliance		HFC-245fa; HFC-134a	HC and Solstice LBA	Manufacturers of foam products, household refrigerated appliances, commercial refrigerated appliances, furniture, and cars
	Flexible PU: slabstock and moulded		None	No transition	
	Rigid PU: commercial refrigeration		HFC-245fa; HFC-134a	HC and Solstice LBA	
	Rigid PU: sandwich		HFC-245fa; HFC-134a	HC	
	Rigid PU and polyisocyanurate laminated boardstock		HFC-245fa	HC	
	Rigid PU: slabstock		None	No transition	
	Rigid PU: marine flotation foam		HFC-245fa; HFC-134a	HC & HFO/H ₂ O Blends	
	PU integral skin		HFC-134a	CO ₂	
	Polystyrene: extruded sheet		HFC-152a	No transition	
	Polystyrene: extruded boardstock and billet foams		HFC-134a	HC & HFO	
	Polyolefin		None	No transition	
	Phenolic		None	No transition	
Commercial Refrigeration	Retail Food Refrigeration (Supermarket Systems and Remote Condensing Units)	(New)	R-404A; R-507A	R-407A	Supermarkets, warehouse clubs/ superstores, convenience stores, drug stores, hotels, cafeterias, specialty food stores, restaurants, and bars
		(Retrofit)	R-404A; R-507A; R-422D	R-407A	
	Retail Food Refrigeration (Stand-Alone Units)	(New)	R-404A; HFC-134a	HC, R-450A	Manufacturers of stand-alone commercial refrigerators/freezers
		(Retrofit)	None	None	None
	Vending Machines	(New)	R-404A; HFC-134a	CO ₂	Manufacturers of vending machines
		(Retrofit)	None	None	None

* As noted previously, for the purposes of quantifying compliance costs, this analysis has made some assumptions regarding which alternatives to model in the transition away from the affected HFCs. These assumptions are not intended to represent the entirety of available alternatives, or to imply that other alternatives are not available. For a fuller accounting of substitutes, please refer to the lists of acceptable substitutes as published under EPA's SNAP Program (www.epa.gov/ozone/snap/).

3 Motor Vehicle Air Conditioning

The EPA has previously examined when automobile manufacturers may be able to transition their fleets to lower GWP refrigerants in support of its rules to extend the greenhouse gas and fuel economy standards for model year (MY) 2017-2025 light-duty vehicles, herein referred to as the Light-Duty Greenhouse Gas (LD GHG) Rule. 77 FR 62624, 62807-810 (October 15, 2012); see also 75 FR 25325, 25431-32 (May 7, 2010) (discussing the same issue for MY 2012-2016 light-duty vehicles).

In support of the LD GHG rule, EPA projected that the industry will make the full transition to lower-GWP refrigerants over the period of time spanning between MY 2017 and MY 2021, and the level of the standard in each of these model years reflects a projected 20 percent increase in substitution in each model year and complete transition by MY 2021 (77 FR 62720/2-3). In support of the assumption of this multi-year transition, the LD GHG rule for MYs 2017-2025 includes an extensive discussion of the refrigerant substitute availability and technical feasibility of transitioning the fleet (77 FR 62720; 62807-810). Factors contributing the transition to low-GWP refrigerants in MVAC are discussed in the preamble to the final rule as well as in the LD GHG rule and its supporting documents. Because the analysis supporting the LD GHG rulemaking accounted for impacts of a full transition by MY 2021 for domestic sales, this analysis considers only export vehicles to estimate costs that would be incurred as a result of this rulemaking.

Light-duty vehicle and truck manufacturers purchase MVAC system components from a third party and then assemble and install the MVAC systems in-house. As such, this analysis assumes that some light-duty vehicle and truck manufacturers directly incur incremental compliance costs associated with modifying MVAC systems to accommodate an alternative refrigerant to HFC-134a (i.e., slightly different components and more costly refrigerant for first-fill) for a portion of their export market. Other potentially affected industries were considered in the preparation of this analysis, including MVAC and other motor vehicle parts manufacturing industries, as well as the general automotive repair industry. These industries were either determined to not experience direct impacts or assumed to pass on direct costs to automobile manufacturers, as described in Exhibit 1 below.

The light-duty vehicle and truck manufacturing industries are matched to NAICS code 336111, *automobile manufacturing*, and NAICS code 336112, *light truck and utility vehicle manufacturing*.⁵ The small business threshold for these industries is defined as a firm with less than 1,000 employees. Applying this definition yields an estimate of 198 small businesses in these industries.⁶ The total number of companies in these industries—including those not characterized as small businesses—is 241. Out of a total of twenty-three automobile manufacturers selling light-duty vehicles in the United States, ten of those twenty-three represent 85% of the light-duty vehicles sold in the United States in MY 2013.⁷

⁵ This industry comprises establishments primarily engaged in manufacturing light trucks and utility vehicles, including light-duty vans, pick-up trucks, minivans, and sport utility vehicles.

⁶ Because Census data disaggregated by employment size are only available by *establishment* size, the definition was conservatively applied as *establishments* with less than 1,000 employees. The total number of small businesses (firms) potentially impacted by the rulemaking was then estimated by applying a scaling ratio between total firms and establishments for this industry (i.e., 174 firms to 188 establishments).

⁷ EPA-HQ-OAR-2014-0198-0113 and EPA-HQ-OAR-2014-0198-0207

Although HFC-134a has been the predominant refrigerant used in MVAC systems in the United States since the 1990s, some manufacturers have recently begun selling cars with HFO-1234yf MVAC systems in the United States, including for instance General Motors' sales of the Cadillac XTS. While these sales currently represent a very small percentage of the overall market, further transition of MVACs to alternative refrigerants is expected in response to the joint rulemakings by EPA and the National Highway Traffic Safety Administration (NHTSA) to reduce GHG emissions and improve fuel economy of light-duty vehicles.⁸ Adopting MVAC systems with low-GWP refrigerants is one of many strategies to reduce GHG emissions in this sector. The technical support document for EPA's LD GHG final rule estimates that for MY 2017, 20% of the U.S. market will have adopted alternative MVAC systems, and that in each subsequent year the penetration will increase an additional 20%, reaching 100% by MY 2021 (EPA/NHTSA 2012). This analysis adopts these assumptions, with the caveat that these penetrations are applied only to a given manufacturer's vehicle production for domestic sales. This analysis conservatively assumes that all manufacturers would continue to produce light-duty vehicles and trucks containing HFC-134a for export, but that none of the exporting manufacturers are small businesses.

Table 4 below presents the number of small businesses under the applicable NAICS codes estimated to be potentially directly affected by the regulatory changes. EPA assumes that none of the companies that are manufacturing new light-duty vehicles and trucks for export are small businesses.

Table 4: Estimated Number of Small Light-Duty Vehicle Manufacturers Affected ^a

Estimated Number of Small Businesses Affected	NAICS 336111 <i>Automobile Manufacturing</i>	NAICS 336112 <i>Light Truck and Utility Vehicle Manufacturing</i>	Total
All Production	0 ^b	0 ^b	0
Production for Export Only	155 ^b	43 ^b	198
Total	155 ^b	43 ^b	198
Total Number of Small Businesses	155 ^b	43 ^b	198

^a Based on analysis using Census Bureau (2007). The total number of companies in these industries—including those not characterized as small businesses—is 241.

^b 0% of small businesses assumed to be affected.

⁸ The EPA/NHTSA Final Rulemaking to Establish 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards was issued August 28, 2012.

Exhibit 1: Related Industries Not Directly Affected by the Rulemaking

Other Motor Vehicle Parts Manufacturing (NAICS 336390)—this industry will need to manufacture certain modified MVAC system components to develop alternative designs that can deliver comparable performance to HFC-134a systems and meet EPA requirements (e.g., modified suction lines, cooling modules, etc.). While there may be a minimal cost associated with these modifications, for the purpose of this analysis, any such costs are assumed to be passed on to automobile manufacturers. Further, many of these businesses are expected to transition to the manufacture of such modified components under the baseline, given current industry trends and other regulatory incentives and requirements.

Automotive Repair Industry (NAICS 811111)—this industry is required to use recovery equipment under Section 609 of the Clean Air Act, regardless of the refrigerant. Although the transition to new refrigerant(s) may facilitate the purchase of new refrigerant recovery devices to accommodate those new refrigerants—the associated costs are considered to be required pursuant to Section 609 rather than resulting from this final rule.

3.1 Estimated Economic Impact on Affected Small Entities

This section summarizes the annual compliance costs for light-duty vehicle and truck manufacturers, and provides a comparison of those costs to average annual sales per firm. For the purposes of this analysis, compliance costs were estimated based on the assumption that HFC-134a MVACs would be replaced by HFO-1234yf, although other SNAP-approved alternatives also exist.

Light-duty vehicle and truck manufacturers purchase either MVAC system components or fully-assembled MVACs systems which they install in-house. Costs to manufacturers were estimated based on per-system costs of alternative systems, as identified in EPA’s report on *Global Mitigation of Non-CO₂ Greenhouse Gases: 2010-2030* (EPA 2013), and converted to 2013 dollars. The incremental per-system costs of assembling an alternative MVAC system compared to an HFC-134a system is assumed to be about \$62/unit. These incremental costs are less than 1% relative to the total direct manufacturing cost for a light-duty vehicle or truck.

Because no small businesses are expected to be manufacturing vehicles for export, the annual compliance cost as a percentage of average sales per small business (i.e., the sales test) is zero, as shown in Table 6 below.

Table 5: Estimated Economic Impact on Small Entities in the Automobile Manufacturing Industry (Sales Test)

NAICS	Industry Name	Annual Compliance Cost as a Percentage of Average Sales per Small Business Establishment
336111	Automobile manufacturing	0%
336112	Light truck and utility vehicle manufacturing	0%

4 Aerosols

The regulatory changes are expected to affect all aerosol products, with some exceptions for certain medical and technical aerosols. Manufacturers of aerosol products containing propellants listed as unacceptable or those that do not meet the criteria for the exceptions are required to reformulate or redesign products to use alternative propellants or alternative delivery systems by the dates specified in the final rule.

4.1 Small Entities Potentially Subject to the Rulemaking

The U.S. aerosol industry is comprised of the following three product categories:

- **Consumer Aerosols** – A wide variety of personal care products using aerosols, including cosmetics, hairspray, body sprays, and deodorants are covered by this category along with a wide variety of other products such as: tire inflators and other automotive products (e.g., auto lubricants, brake cleaners); noise horns and safety horns; animal repellants; spray paint; spray adhesive with various applications; cleaning products; eyeglass and keyboard dusters; room fresheners; food dispensing products; freeze sprays for removal of chewing gum, pet excrement, and other wastes; and novelty aerosols (e.g., artificial snow, plastic string, noise makers, and cork poppers).
- **Technical Aerosols** – This grouping represents highly specialized products for certain commercial and industrial applications that are not for personal use, which generally include (but are not limited to) those products excepted from the Clean Air Act Section 610 nonessential products bans (subpart C of 40 CFR part 82). Products include: cleaners (e.g., electronic contact cleaners, flux removers, degreasers); pesticides (e.g., certain wasp and hornet sprays, aircraft insecticides); mold release agents; certain dusters (e.g., for photographic negatives, semiconductor chip manufacture, specimens for observation under electron microscope); and spinnerette lubricant/cleaning sprays. Other miscellaneous products such as document preservation sprays and products for the functional and sensitivity testing of smoke detectors are also considered in this category.
- **Medical Aerosols** – This grouping includes topical anesthetic sprays, products for removing bandage adhesives from skin, and wound care sprays (among excepted products) and liquid bandages, wart removal sprays, antifungals, and calamine sprays, among the products that would be restricted from using HFC-134a and HFC-227ea. Aerosol propellants are also used in metered dose inhalers (MDIs); however, use of HFC-134a and HFC-227ea and blends of these two HFCs in MDIs is excepted from the regulatory restriction.

The industries directly affected by the regulatory changes were identified using NAICS codes, as shown in Table 6 below. However, the broader industries represented by these NAICS codes may also manufacture a majority of products which are not aerosols, such as creams, polishes, lotions, and other chemicals and equipment. In addition to manufacturing many non-aerosol products, these manufacturers are also likely to produce aerosol products that are already using non-HFC technologies.

In fact, while this rulemaking lists HFC-125 as unacceptable and restricts HFC-227ea to metered dose inhalers and HFC-134a to certain technical and medical aerosols, HFC-125 and HFC-227ea⁹ are not currently used as aerosol propellants. IPCC (2011) estimates that in developed countries, more than 98% of non-medical aerosols

⁹ HFC-227ea is used as a propellant in MDIs, which is excepted.

now use non-ozone-depleting, low-GWP propellants (e.g., hydrocarbons, dimethyl ether, CO₂, or nitrogen). As such, this rulemaking would serve to avoid future use of these HFC propellants.

With regard to HFC-134a, primarily technical aerosol products continue to use this chemical as propellants for specific purposes (e.g., specialized product cleaners, aircraft pesticides) due to performance or safety limitations (e.g., flammability). The following technical aerosol applications are excepted from restrictions on HFC-134a. This list also incorporates those applications that were previously excepted from the nonessential products regulations (EPA 2010):

- Certain medical devices including metered dose inhalers;
- Lubricants, coatings, or cleaning fluids for aircraft maintenance;
- Lubricants, coatings, or cleaning fluids for electrical, electronic or photographic equipment;
- Mold release agents;
- Spinnerette lubricant/cleaning sprays
- Document preservation sprays;
- Pesticides for use near electrical wires or in aircraft; and
- Products for the sensitivity testing of smoke detectors.

Among consumer products, tire inflators are one significant remaining use of HFC-134a propellant. Some brands of tire inflators in the United States, and all those in Europe, use hydrocarbons as the propellant. Products for the functional and sensitivity testing of smoke detectors are another remaining use of HFC-134a propellant; however, these products are considered to be part of a niche market. Both aerosol tire inflators and products for the functional testing of smoke detectors are subject to the regulatory prohibition on use of HFC-134a as a propellant.

Table 6 below presents the estimated number of entities expected to be directly affected. A significant portion of the aerosol product manufacturing industry has already transitioned out of the HFCs for regulation or is excepted. However, two tire inflator manufacturers¹⁰ and three smoke detector tester manufacturers¹¹ using HFC-134a propellant are considered to be small businesses and are expected to be affected by this rulemaking.

Table 6: Estimated Number of Aerosol Small Businesses Affected by the Regulation

NAICS Code	Industry Name	Relevant Aerosol Products Included	Small Business Threshold (Number of Employees)	Percent of Industry Assumed to Use HFCs Affected by Regulatory Changes	Estimated Number of Small Businesses Affected
325620	Perfumes, makeups and other toiletries	Aerosol hairsprays, Cologne and perfume manufacturing, Deodorants	500	0%	0

¹⁰ The two manufacturers, Radiator Specialty Company and Warren Distribution, Inc. were determined to be small businesses based on employee data available from Dun and Bradstreet (2014) and the small business threshold for NAICS code 325998 of 500 employees. Other producers of tire sealants containing HFC-134a (e.g., ITW Global Brands, Valvoline Co.) exceed the small business size threshold.

¹¹ The three manufacturers, SDI/detectortesters, CRC Industries, and HIS Fire & Safety Group LLC were determined to be small businesses based on discussion with EPA, available employee data, and the small business threshold for NAICS code 325998 of 500 employees. Another producer of products for functional testing of smoke detectors containing HFC-134a (i.e., Interlogix) exceeds the small business size threshold.

NAICS Code	Industry Name	Relevant Aerosol Products Included	Small Business Threshold (Number of Employees)	Percent of Industry Assumed to Use HFCs Affected by Regulatory Changes	Estimated Number of Small Businesses Affected
325612	Polishes and other sanitation goods	Air fresheners, Household cleaning products, Specialized dusters, Degreasers (household), Deodorants (non-personal), Aircraft cleaner	500	E/0% ^a	0
325520	Adhesive manufacturing	Household maintenance adhesives, Caulking, Sealants	500	0%	0
324191	Petroleum lubricating oil and grease manufacturing	Auto products, Lubricants	500	E/0% ^a	0
325510	Paint and coating manufacturing	Dispersions, Paint, Enamel paint, Latex paint, Coatings	500	0%	0
325998	All other miscellaneous chemical product and preparation manufacturing	Degreasers, Defluxers , Freeze sprays, Mold release agents, Wasp and hornet spray^b, Spinnerette lubricant sprays, Document preservation sprays , Tire inflators, Products for functional testing of smoke detectors	500	E/0% ^c	5
325412	Pharmaceutical preparation manufacturing	Freeze sprays (wart treatment), Calamine spray	750	0%	0
325199	All other basic organic chemical manufacturing	Anti-fungal sprays	1,000	0%	0
339113	Surgical appliance and supplies manufacturing	Liquid bandages	500	0%	0

Note: Bolded items have been identified as products that are likely to use HFC-134a, but are excepted from the regulatory restrictions; "E" represents entities that are found to be excepted from the regulatory restriction.

^a Some products in this category are excepted from the regulatory restriction. For restricted products, it is expected that all manufacturers would already have transitioned out of the HFCs in the regulation, thus 0% are expected to be affected.

^b Only wasp and hornet spray for use near power lines would qualify for an exception, not household sprays.

^c The majority of the products in this category are excepted from the regulatory restriction. For the restricted products, it is expected that all manufacturers would already have transitioned out of the HFCs in the regulation. However, aerosol tire inflators containing HFC-134a would be subject to the regulatory changes. Two manufacturers that produce tire inflators and three manufacturers of products for functional testing of smoke detectors with HFC-134a propellant were identified as small businesses.

4.2 Estimated Economic Impact on Affected Small Entities

Table 7 presents a summary of the annualized compliance costs as a percentage of average annual sales for the small businesses affected. As shown, there is no economic impact for small businesses in most covered industries, due to the already widespread use of non-HFC-134a aerosol propellants, and exceptions for HFC-134a and HFC-227ea in MDIs, and HFC-134a in technical aerosols for specialized uses. In addition, small businesses manufacturing tire inflators using HFC-134a propellant are expected to experience cost savings on an annualized basis,¹² due to the lower cost of hydrocarbon-based propellant. The specific assumptions used to calculate annualized compliance costs for tire inflator manufacturers are presented after the table.

¹² This screening assessment assumes facilities produce approximately 1 million aerosol cans annually; however, facilities that manufacture as few as 200,000 aerosol cans per year (assuming lower end of up-front costs) can expect to see cost savings as a result of compliance with the regulatory changes. If a facility incurs conversion costs on the higher end of the range, the facility would have to manufacture 670,000 aerosol cans per year to see cost savings as a result of regulatory compliance.

Table 7: Estimated Economic Impact on Small Businesses (Sales Test)

NAICS	Industry Name	Annual Compliance Cost as a Percentage of Annual Sales per Small Business
325620	Perfumes, makeups and other toiletries	NA
325612	Polishes and other sanitation goods	NA
325520	Adhesive manufacturing	NA
324191	Petroleum lubricating oil and grease manufacturing	NA
325510	Paint and coating manufacturing	NA
325998	All other miscellaneous chemical product and preparation manufacturing	<0%*-2.6%
325412	Pharmaceutical preparation manufacturing	NA
325199	All other basic organic chemical manufacturing	NA
339113	Surgical appliance and supplies manufacturing	NA

NA indicates that no small entities are expected to be subject to this rulemaking, and thus compliance costs are zero.

* On an annualized basis, tire inflator manufacturer small businesses are expected to experience some cost savings as a result of compliance.

Aerosol Tire Inflators-- For the purposes of quantifying compliance costs for this analysis, it was assumed that tire inflator manufacturers still using HFC-134a would transition to a hydrocarbon-based propellant (usually a mixture of propane, butane, and isobutane). One-time capital costs for conversion were assumed to range between \$342,000 and \$1.3 million in 2013 dollars, which covers costs to convert a facility to accommodate a flammable aerosol propellant (e.g., installing sensors and storage capacity), test and certify equipment to Underwriter's Laboratory (UL) standards, and the potential need to relocate facilities to regions where hydrocarbon use is considered safe (EPA 2013). These upfront costs are offset by annual savings of about \$260,000 per facility associated with a lower-cost hydrocarbon-based propellant. Incremental annual operating costs were assumed to be zero, based on the expectation that companies already have fire insurance and other fire safety precautions intact (EPA 2013). All costs and savings were developed based on a model facility assumed to manufacture 1 million consumer aerosol cans¹³ per year and were annualized assuming a lifetime of 10 years.

Aerosol Products for Functional and Sensitivity Testing of Smoke Detectors-- For the purposes of quantifying compliance costs for this analysis, it was assumed that manufacturers of products for functional and sensitivity testing of smoke detectors still using HFC-134a would transition to HFO-1234ze, as the product requires a non-flammable propellant. One-time capital costs for conversion were assumed to be between \$105,000 and \$530,000 in 2013 dollars, depending on the need for bulk storage (EPA 2013). Incremental annual operating costs were assumed to be \$1,250 per facility associated with the higher cost of HFO-1234ze than other HFC propellants (i.e., HFC-134a) (EPA 2013). All costs were developed based on a model facility assumed to manufacture 10,000 smoke detector tester aerosol cans¹⁴ per year and were annualized assuming an equipment lifetime of 10 years.

¹³ Each aerosol can is assumed to contain an HFC-134a aerosol propellant charge of two ounces (EPA 2013).

¹⁴ *Ibid.*

5 Foam Sector

The regulatory changes are expected to affect manufacturers of domestic and commercial refrigerated appliances, polyurethane foam products, polystyrene foam products, polyolefin foams, polyisocyanurate foams, and phenolic foams.

5.1 Small Entities Potentially Subject to the Rulemaking

The industries directly affected by the regulatory changes in the foam sector were identified using NAICS codes, as shown in Table 8. Foam end-uses included under each of the broader industries are also shown. The remaining sections analyze the number of small businesses under each NAICS code affected by the regulatory changes.

Table 8: NAICS Codes for Foams

NAICS Code	Industry Name	Relevant Foam End-Uses
326140	Polystyrene foam product manufacturing	Polystyrene: extruded boardstock and billet
		Polystyrene: extruded sheet
335222	Household refrigerator and home freezer manufacturing	Rigid polyurethane: (household) appliance
333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	Rigid polyurethane: commercial refrigeration
326150	Urethane and other foam product (except polystyrene) manufacturing	Flexible polyurethane: slabstock and moulded
		Rigid polyurethane: sandwich panels
		Rigid polyurethane: slabstock
		Rigid polyurethane: marine flotation foam
		Rigid polyurethane and polyisocyanurate laminated boardstock
		Polyurethane integral skin
		Polyolefin
		Phenolic

5.1.1 Polystyrene Foam Product Manufacturing (NAICS code 326140)

The extruded polystyrene (XPS) boardstock and billet manufacturing and XPS sheet manufacturing industries fall within the broader NAICS code 326140, *polystyrene foam product manufacturing*. All known companies that manufacture extruded polystyrene (XPS) foam in the United States exceed the small business size threshold for this NAICS code (defined as a firm with less than 500 employees). Thus, no small businesses are estimated to be directly affected by the regulatory changes.

5.1.2 Household Refrigerator and Home Freezer Manufacturing (NAICS code 335222)

The household appliance foam industry is associated with NAICS code 335222, *household refrigerator and home freezer manufacturing*.¹⁵ By 2020, when the final unacceptability decision for this end-use becomes effective, some manufacturers are expected to have transitioned out of HFCs. Specifically, among domestically

¹⁵ In contrast to many other polyurethane foam types, household appliance foam is blown directly into the appliance at time of appliance manufacture.

manufactured appliances on the market in 2020, approximately 5% are assumed to still use HFC-134a-blown foam, while 33% use HFC-245fa and the remaining 62% use hydrocarbons (EPA 2012). The regulatory changes are therefore assumed to affect 38% of the small businesses in manufacturing appliance foam, since an estimated 38% of companies would need to transition away from HFC-134a and HFC-245fa.

The small business threshold for this industry is defined as a *firm* with fewer than 1,000 employees; however, Census data was only available by *establishment* size. Conservatively applying this threshold to establishments yielded the total number of small establishments. To estimate the total number of small businesses (firms) affected, a scaling ratio was used between total firms and establishments for this industry (i.e., 19 firms to 25 establishments). Table 9 below presents the number of small businesses estimated to be directly affected.

Table 9: Estimated Number of Appliance Small Businesses Affected

NAICS Code	Industry Name	Total Number of Small Businesses	Estimated Number of Small Businesses Affected
335222	Household refrigerator and home freezer manufacturing	14 ^a	5

^a Based on U.S. Census Bureau (2007). The total number of companies in this industry—including those not characterized as small businesses—is 19.

5.1.3 Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing (NAICS code 333415)

The commercial refrigeration foam industry is associated with NAICS code 333415, *air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing*.¹⁶ By 2020, when the final unacceptability decision for this end-use becomes effective, some manufacturers are expected to have transitioned out of HFCs. Specifically, among domestically manufactured commercial refrigeration equipment on the market in 2020, approximately 5% are assumed to still use HFC-134a-blown foam, while 44% use HFC-245fa and the remaining 51% use hydrocarbons (EPA 2012). As such, the regulatory changes are assumed to affect 49% of the small businesses manufacturing commercial refrigeration foam, since an estimated 49% of companies could need to transition away from HFC-134a and HFC-245fa.

The small business threshold for this industry is defined as a *firm* with less than 750 employees; however, Census data were only available by *establishment* size. Conservatively applying this threshold to establishments yielded the total number of small establishments. To estimate the total number of small businesses (firms) affected, a scaling ratio was used between total firms and establishments for this industry (i.e., 730 firms to 902 establishments).

Further, because NAICS code 333415 reflects the manufacturing of a wide range of equipment types, including those that would not be affected, the relevant subset of the economic sector—NAICS code 3334153 *commercial refrigerators and related equipment*—was used to identify the number of businesses that could be affected. Data on the number of establishments at the disaggregated NAICS code 3334153 level, however, are not available; as a proxy, Census data on the value of product shipments of NAICS code 3334153 relative to the broader NAICS code 333415 were used (U.S. Census 2007, 2014). Based on these data, it was estimated that

¹⁶ In contrast to many other polyurethane foam types, commercial refrigeration foam is blown directly into commercial appliances at time of manufacture.

13.5% of the small businesses in NAICS code 333415 manufacture commercial refrigeration equipment and could be affected. Table 10 below presents the number of small businesses estimated to be directly affected.

Table 10. Estimated Number of Commercial Refrigeration Small Businesses Affected

NAICS Code	Industry Name	Total Number of Small Businesses	Estimated Number of Small Businesses Affected
333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	95 ^a	47

^a Based on U.S. Census Bureau (2007). The total number of firms manufacturing commercial refrigeration equipment—including those not characterized as small businesses—is estimated to be 99.

5.1.4 Urethane and Other Foam Product (Except Polystyrene) Manufacturing (NAICS code 326150)

The remaining foam types affected by the regulatory changes—flexible PU slabstock/moulded, marine flotation foam, sandwich panels, integral skin foams, rigid PU slabstock, rigid PU/PIR laminated boardstock, polyolefin, and phenolic foams—all fall under NAICS code 326150, *urethane and other foam product (except polystyrene) manufacturing*.

Within this broader NAICS code industry, only a portion of companies would be expected to manufacture PU foam products with HFC-134a, or other HFCs/HFC blended blowing agents—namely HFC-365mfc and HFC-245fa. The proportion for each of the foam types was estimated using a two-step process and data from EPA’s Vintaging Model (EPA 2012):

1. First, the amount of blowing agent (all types) used specifically for each of the foam types was compared to the total in the NAICS code. This yielded a proxy for the percentage of companies assumed to be manufacturing each foam type within this NAICS code.
2. Second, the amounts of (a) HFC-134a blowing agent and (b) HFC blowing agents other than HFC-152a were calculated for each foam type and compared to the total amount of blowing agent used for each foam type (EPA 2012). This yielded a proxy for the percentage of companies in each foam type that are using HFC blowing agents listed as unacceptable.

The combined result of these two steps yields for each PU foam type the percent of companies assumed to be manufacturing covered foam products with certain HFCs that could be subject to the regulatory changes. These percentages are summarized in Table 11.

Table 11: Assumptions about the Percentage of Affected Entities in NAICS Code 326150

Relevant Foam Types	% of Entities Assumed to be Affected
Flexible polyurethane: slabstock and moulded	0% ^a
Rigid polyurethane: sandwich	1.0%
Rigid polyurethane: slabstock	0%
Rigid polyurethane: marine flotation foam	2.2% ^b
Rigid polyurethane and polyisocyanurate laminated boardstock	9.5%
Polyurethane integral skin	0.2%
Polyolefin	0%
Phenolic	0% ^a

^a Because the HFCs listed as unacceptable are not currently in use, 0% of small businesses are assumed to be affected.

^b Assumed to be 15% of the entire rigid polyurethane: spray foam market.

The small business threshold for this industry is defined as a *firm* with less than 500 employees; however, while the Census Bureau provides the total number of firms and establishments in the industry, it only provides disaggregated data by employee size for *establishments*. To estimate the total number of small businesses (i.e., firms with less than 500 employees) affected by the regulatory changes, a scaling ratio between total number of firms and establishments for this industry (i.e., 482 firms to 685 establishments) was applied to the number of establishments with less than 500 employees. Table 12 below presents the number of small businesses estimated to be directly affected.

Table 12: Estimated Number of Small Businesses Manufacturing Non-Appliance PU Foam Types Affected

NAICS Code	Industry Name	Total Number of Small Businesses	Foam Type	Estimated Number of Small Businesses Affected
326150	Urethane and other foam product (except polystyrene) manufacturing	481 ^a	Flexible polyurethane: slabstock and moulded	0
			Rigid polyurethane: sandwich	5
			Rigid polyurethane: slabstock	0
			Rigid polyurethane: marine flotation foam	11
			Rigid polyurethane and polyisocyanurate laminated boardstock	46
			Polyurethane integral skin	1
			Polyolefin	0
			Phenolic	0
Total				61

^a Based on U.S. Census Bureau (2007). Includes total number of small business establishments for all urethane foam types, including those not listed in table. The total number of companies in this industry—including those not characterized as small businesses—is 482.

5.1.5 Summary of Small Business Impacted in the Foam Sector

Table 13 below summarizes the number of small businesses estimated to be impacted in each NAICS code and foam type.

Table 13: Estimated Number of Small Businesses Affected in the Foam Sector

NAICS Code	Industry Name	Relevant Foam End-Uses	Estimated Number of Small Businesses Affected
326140	Polystyrene foam product manufacturing	Polystyrene: extruded boardstock and billet	0
		Polystyrene: extruded sheet	0
335222	Household refrigerator and home freezer manufacturing	Rigid polyurethane (household) appliance	5
333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	Rigid polyurethane: commercial refrigeration	47
326150	Urethane and other foam product (except polystyrene) manufacturing	Flexible polyurethane: slabstock and moulded	0
		Rigid polyurethane: sandwich	5
		Rigid polyurethane: slabstock	0
		Rigid polyurethane: marine flotation foam	11
		Rigid polyurethane and polyisocyanurate laminated boardstock	46
		Polyurethane integral skin	1
		Polyolefin	0

NAICS Code	Industry Name	Relevant Foam End-Uses	Estimated Number of Small Businesses Affected
		Phenolic	0
Total			114

Note: Totals may not sum due to independent rounding.

5.2 Estimated Economic Impact on Affected Small Entities

This section summarizes the annual compliance costs for polyurethane, polystyrene, and appliance foam manufacturers, and provides a comparison of those costs to average annual sales per establishment. All costs and savings are expressed in 2013 U.S. dollars. Where available and appropriate, compliance costs were estimated based on EPA's report on *Global Mitigation of Non-CO₂ Greenhouse Gases: 2010-2030* (EPA 2013). Because EPA (2013) costs are based on typical U.S. facility sizes, in some cases, they were considered to overestimate incremental compliance costs for a small business, which is likely to have fewer production lines (and/or lower run-times) and lower annual blowing agent consumption. For those foam types for which EPA (2013) cost estimates were not appropriate or available, incremental capital and operating costs were estimated based on industry input, as available, and costs reported in project proposals submitted to the Multilateral Fund (MLF) of the Montreal Protocol, and scaled according to actual project funds approved by the Executive Committee of the MLF. Among foam sector projects submitted to the MLF, selections were based on analysis of which project provided the most reasonable proxy for U.S. small businesses; considerations included facility size (i.e., annual blowing agent use) and alternative used. In consideration of the uncertainty inherent in these cost estimates, capital costs for each of the end-uses were increased by 20% to explore the sensitivity of the results to these costs and develop a higher and lower range of the potential compliance costs.

Used as a proxy for U.S. small business compliance costs, these MLF project costs are subject to several limitations, including: funding requested and approved by the Executive Committee of the MLF is based on myriad complex considerations such as cost-effectiveness thresholds for specific foam project types, foreign ownership stakes in domestic companies, assumptions about company counterpart contributions to conversion costs, and so on, which may affect the accuracy of the cost estimates when transferred to the U.S. context; MLF costs are based on those estimated or reported for developing countries, which may not be the same as those experienced in the United States; and MLF costs are based on facility conversions from HCFC-141b blowing agent, rather than HFCs.

Table 14 presents a summary of the annualized compliance costs as a percentage of the average annual sales for each foam type. Average annual sales per establishment were calculated by dividing total value of shipments (as a proxy for sales) by the number of establishments, for each small business establishment size (e.g., 0-4 employees, 5-9 employees, 10-19 employees, etc.). Because average annual sales were calculated by establishment size, a range is provided for annual compliance costs as a percentage of annual sales. In general, annual compliance costs represent a higher percentage of annual sales for smaller establishments. The specific assumptions used for each foam type to estimate annualized compliance costs are presented after the table.

Table 14: Estimated Economic Impact on Small Entities in the Foam Manufacturing Industry (Sales Test)

NAICS Code	Industry Name	Foam Type	Annual Compliance Cost as a Percentage of Average Sales per Establishment
326140	Polystyrene foam product manufacturing	Polystyrene: extruded boardstock and billet	0% ^a
		Polystyrene: extruded sheet	0% ^b
335222	Household refrigerator and home freezer manufacturing	Rigid polyurethane: (household) appliance	<0% ^c –2.4%
333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	Rigid polyurethane: commercial refrigeration	<0% ^c –3.9%
326150	Urethane and other foam product (except polystyrene) manufacturing	Flexible polyurethane: slabstock and moulded	0% ^b
		Rigid polyurethane: sandwich	<0.1%–6.5%
		Polyurethane integral skin	<0.1%–6.6%
		Rigid polyurethane: slabstock	0%
		Rigid polyurethane: marine flotation foam	<0.1%–48.0%
		Rigid polyurethane and polyisocyanurate laminated boardstock	<0.1%–15.5%
		Polyolefin	0%
		Phenolic	0% ^b

^a All of the manufacturers in this end-use are large businesses (i.e., those with more than 499 employees).

^b Because the HFCs listed as unacceptable are not currently in use, annual compliance costs are assumed to be zero.

^c On an annualized basis, the largest-sized small businesses (i.e., those with 500 to 999 employees) are expected to experience some cost savings as a result of compliance with this regulatory change.

5.2.1.1 Polystyrene Foam Product Manufacturing

- XPS Sheet and Boardstock and Billet – All known XPS manufacturers of boardstock and billet are larger businesses (i.e., having more than 499 employees) and therefore do not qualify as small businesses for the purposes of this analysis. XPS sheet is manufactured using alternatives other than the HFCs listed as unacceptable, and this analysis assumes the rule will not result in costs for this end-use.

5.2.1.2 Household Refrigerator and Home Freezer Manufacturing

- **Rigid Polyurethane: (Household) Appliance**— Manufacturers using HFC-245fa and HFC-134a would be impacted by the regulatory changes. For the purposes of quantifying compliance costs for this analysis, it was assumed that companies still using HFC-245fa and HFC-134a would transition to either hydrocarbons or Solstice LBA. Hydrocarbons may be a more cost-effective option, but Solstice LBA is conservatively assumed to be adopted to help achieve energy efficiency standards and/or to avoid incurring upfront capital costs. Specifically, establishments with zero to nine employees are assumed to transition fully to Solstice LBA, while establishments with 10 to 999 employees are assumed to transition 50% to Solstice LBA and 50% to hydrocarbons.

The range of facility transition costs were based on the costs to transition from HFC-245fa, as reported in EPA (2013). Capital facility costs to convert to hydrocarbons were assumed to be between \$5.1 million and \$6.1 million per facility, but these costs are offset by annual savings of up to \$1.4 million per facility due to lower blowing agent costs; these savings are varied depending on facility size (i.e., number of

units produced). The short-term impact of the initial capital expenditures would be expected to depend in part on how small businesses are able to finance their upfront costs.

Conversely, no capital costs were assumed to convert to Solstice LBA (since this option is considered to be a near drop-in replacement for HFC-245fa), but annual costs per facility were estimated to be between \$2,000 and \$900,000 per facility,¹⁷ due to higher blowing agent costs. Annual costs/savings associated with blowing agent costs were scaled by the number of appliances manufactured per facility, which was estimated based on reported value of shipments and an assumed value of \$1,500 per appliance. All costs were annualized assuming a facility lifetime of 25 years.

5.2.1.3 Commercial and Industrial Refrigeration Equipment Manufacturing

- **Rigid Polyurethane: Commercial Refrigeration**—Manufacturers using HFC-245fa and HFC-134a would be impacted. For the purposes of quantifying compliance costs for this analysis, it was assumed that companies still using HFC-245fa and HFC-134a would transition to hydrocarbons or Solstice LBA.

Facility transition costs were based on the costs to transition from HFC-245fa, as reported in EPA (2013). Capital costs to transition to hydrocarbons were assumed to be approximately between \$1.3 million and \$1.6 million per facility, while net annual savings are estimated to be up to \$992,000 per facility, due to lower blowing agent costs. The short-term impact of the initial capital expenditures would be expected to depend in part on how small businesses are able to finance their upfront costs.

No capital costs were assumed to convert to Solstice LBA (since this option is considered to be a near drop-in replacement for HFC-245fa), but annual costs per facility were estimated to be between \$500 and \$268,000 per facility,¹⁸ due to higher blowing agent costs. Annual costs/savings associated with blowing agent costs were scaled by the number of appliances manufactured per facility, which was estimated based on reported value of shipments and an assumed value of \$2,000 per equipment. All costs were annualized assuming a facility lifetime of 25 years.

5.2.1.4 Urethane and Other Foam Product (Except Polystyrene) Manufacturing

- **Flexible Polyurethane**—As previously mentioned, this foam type is currently manufactured in the United States using only hydrocarbons. Therefore, prohibiting the use of HFCs in this end-use would not be expected to impact small businesses. The regulatory changes would serve to avoid use of HFCs.
- **Rigid Polyurethane: Sandwich Panels**—The regulatory changes would be expected to impact manufacturers producing sandwich panel foam using HFC-134a and HFC-245fa blowing agent. For the purposes of quantifying compliance costs for this analysis, it was assumed that companies still using HFC-134a or HFC-245fa would transition to hydrocarbons. One time-capital costs for conversion were assumed to be between \$183,000 and \$220,000 for a typical firm; this is assumed to cover retrofitting or replacement of foam dispensers, purchase of a pre-mixing system, retrofitting of jigs, purchase of safety related equipment, and conducting trials, training, testing and certification (UNEP 2012, UNEP 2013a).

¹⁷ Depending on the number of appliances assumed to be manufactured per facility and the cost of Solstice LBA (which was assumed to range from \$14 to \$17 per kilogram).

¹⁸ Depending on the number of equipment assumed to be manufactured per facility and the cost of Solstice LBA (which was assumed to range from \$14 to \$17 per kilogram).

Incremental annual operating costs were assumed to be zero; while an increase in operating costs may be experienced associated with the use of hydrocarbons—due to the need for raw materials for fire retardants—these costs are not expected to outweigh the annual savings associated with the lower incremental blowing agent cost. Indeed, this assumption is conservative given the significant annual cost savings assumed in EPA (2013) for other foam types transitioning to hydrocarbons. Costs were annualized over an assumed facility lifetime of 25 years.

- **Rigid Polyurethane: Marine Flotation Foam**— Foam is used in boat manufacturing for both structural and flotation purposes. Polyurethane foams for flotation purposes are available in blocks, or sheets, but the most significant application is closed-cell polyurethane injection foams, or pour-in-place application. Reformulation costs would be borne by polyol and isocyanate manufacturers and systems houses. System houses typically develop appropriate formulations through an experimental process making improvements incrementally until the ideal end-use properties are developed. Thus, the regulatory changes would be expected to impact marine flotation foam manufacturers (i.e., Urethane and Other Foam Product (Except Polystyrene) Manufacturing) using HFC-134a and HFC-245fa, not boat manufacturers.¹⁹ Depending on the complexity of and time required for this development process, incremental costs may or may not be passed on to end-users.

It was assumed that companies still using HFC-134a and HFC-245fa would transition to hydrocarbons (e.g., pentane) and HFO/water blends. Transitioning to these blowing agent substitutes are expected to result in a 10% increase in raw material costs for boat manufacturers associated with slightly more foam needed on a volume basis (ICF estimate). This cost would likely be passed on to the consumer (i.e., boat manufacturers would add the incremental cost of the foam, a very small cost compared to other boat costs, to the final price of the fabricated boat). For the purposes of quantifying compliance costs for this analysis, the smaller marine flotation foam manufacturers (i.e., those with less than 10 employees) are expected to transition to HFO/water systems. Of the remaining entities, 50% would be expected to transition to pentane blowing agents and the remaining 50% to HFO/water systems.

Capital costs for transitioning to HFO/water systems were assumed to be between \$210,000 and \$253,000 per facility, covering the cost of formulation development and compliance testing. Incremental annual operating costs were conservatively estimated to be between \$97,000 and \$116,000 per facility, due to higher blowing agent costs (EPA 2013)²⁰; actual costs may be lower given potential efficiency savings. Actual compliance costs may vary based on the size of each manufacturing facility. Costs were annualized over the facility lifetime, assumed to be 25 years.

Capital costs for transitioning to pentane blowing agents were assumed to be between \$210,000 and \$632,000 per facility, associated with hydrocarbon storage systems, replacement or retrofit of existing foaming dispenser including jigs and fixtures, installation of safety related equipment, trials, and certification (UNEP 2010c). Incremental annual operating costs were assumed to be zero; while an increase in operating costs may be experienced associated with the use of hydrocarbons—due to the

¹⁹ The boat manufacturing industry, which can be characterized by the North American Industry Classification System (NAICS) code 336612: Boat Building, is primarily comprised of small businesses (i.e., having less than 500 employees).

²⁰ Assuming Solstice LBA costs between \$14 and \$17 per kilogram.

need for raw materials for fire retardants—these costs are not expected to outweigh the annual savings associated with the lower blowing agent cost.

- **Polyurethane Integral Skin**—The regulatory changes would be expected to impact integral skin manufacturers using HFC-134a, as no other HFCs are assumed to be in use in this application (EPA 2012). It was assumed that companies still using HFC-134a would transition to CO₂. Capital costs were assumed to be between \$184,000 and \$220,000 for a typical firm; this is assumed to cover the purchase or retrofit of foam dispensers, purchase of cooling equipment, purchase of a pre-mixing tank, and trials (UNEP 2012, UNEP 2013a). Incremental annual operating costs were assumed to be zero; while an increase in operating costs may be experienced associated with the use of CO₂, these costs are not expected to outweigh the annual savings associated with the lower incremental blowing agent cost. Indeed, this assumption is conservative given the significant annual cost savings assumed in EPA (2013) for other foam types transitioning to CO₂. Costs were annualized over an assumed 25 year facility lifetime.
- **PU/PIR Laminated Boardstock**—Manufacturers of this foam type rely on HFC-134a, as well as HFC-245fa and hydrocarbons. For the purposes of quantifying compliance costs for this analysis, it was assumed that companies using HFC-134a or HFC-245fa would transition to hydrocarbons. Capital costs for a facility to transition to hydrocarbons were estimated to be approximately between \$432,000 and \$959,000 for one production line that produces 25 MT of blowing agent per year (UNEP 2009, 2011a, 2010c). The capital costs associated with the conversion to hydrocarbons include hydrocarbon storage systems, replacement or retrofit of existing foaming dispenser including jigs and fixtures, installation of safety related equipment, trials, and certification (UNEP 2010c). Incremental annual operating costs were assumed to be zero; while an increase in operating costs may be experienced associated with the use of hydrocarbons—due to the need for raw materials for fire retardants—these costs are not expected to outweigh the annual savings associated with the lower blowing agent cost. This assumption is conservative given the significant annual cost savings assumed in EPA (2013) for other foam types transitioning to hydrocarbons. Costs were annualized over an assumed facility lifetime of 25 years. Although the smallest facilities (i.e., those with less than 20 employees) may face significant annualized compliance costs representing up to about 15% of annual sales for the high capital cost estimate, for the majority of small businesses (38 of 46), compliance costs are estimated at 2% or less of annual sales.
- **Polyolefin**—Previous analysis assumed this foam type to be manufactured in the United States using only hydrocarbons. All known companies that manufacture polyolefin foam using HFC-134a in the United States exceed the small business size threshold for this NAICS code (defined as a firm with less than 500 employees). Thus, no small businesses are estimated to be directly affected by the regulatory changes.
- **Phenolic**—This foam type is assumed to be manufactured in the United States using only hydrocarbons. Therefore, prohibiting the use of HFCs in this end-use would not be expected to impact small businesses.

6 Commercial Refrigeration

The regulatory changes are expected to affect the retail food refrigeration end-use, including new and retrofitted supermarket systems, remote condensing unit systems, and stand-alone units. The regulatory changes are also expected to affect new and retrofitted vending machines.

6.1 Small Entities Potentially Subject to the Rulemaking

6.1.1 Remote Retail Food Equipment (Supermarket Systems and Remote Condensing Units)

Supermarkets and other retail food establishments that use remote refrigeration systems (i.e., rack systems and remote condensing units) to cool food, beverages, and other refrigerated or frozen products prior to sale are required to use alternative refrigerants to the ones listed as unacceptable by the regulation in new and retrofitted equipment beginning in 2016, 2017, or 2018 (depending on the end-use and application).

Remote refrigeration systems are generally defined as systems that consist of various components linked through a refrigerant piping network. Rack systems, which are most commonly used in supermarkets as well as warehouse clubs and superstores, consist of racks of multiple compressors and other components that are connected to a remote condenser and linked to display cases, reach-ins, and walk-ins through a piping network. Remote condensing units, which are more commonly used in convenience stores and other medium-sized retail food establishments, consist of one or two compressors, one condenser, and one receiver assembled into a condensing unit system, which is then linked to display cases, reach-ins, or walk-ins through a piping network. Since new remote refrigeration systems are typically installed and charged onsite, and existing systems are also retrofitted onsite, the economic impact of complying with this regulation is expected to be most directly incurred by the end-users of the equipment.

6.1.1.1 Affected Industries

End-users of remote retail food equipment include supermarkets, warehouse clubs/superstores, convenience stores, drug stores, hotels, cafeterias, specialty food stores, restaurants, and bars. Table 15 below presents the industries that are expected to be affected (by NAICS code), the total number of firms represented by each industry, the small business threshold for each industry, and the resulting number of small businesses.

Table 15: NAICS Codes for Affected Retail Food Industries

NAICS Code	Industry Name	Total Number of Firms in Each Industry*	Small Business Threshold: Annual Sales per Firm	Total Number of Small Businesses in Each Industry
44511	Supermarkets and other grocery (except convenience) stores	34,009	\$30 million	33,332
44512	Convenience stores	16,944	\$27 million	16,918
44521	Specialty food stores – meat markets	4,628	\$7 million	4,532
44522	Specialty food stores – fish and seafood markets	1,591	\$7 million	1,547
44523	Specialty food stores – fruit and vegetable markets	2,082	\$7 million	1,983
445291	Specialty food stores – baked goods stores	2,229	\$7 million	2,220
445292	Specialty food stores – confectionary and nut stores	1,619	\$7 million	1,600
445299	All other specialty food stores	3,182	\$7 million	3,162
4453	Beer, wine, and liquor stores	23,206	\$7 million	22,697

NAICS Code	Industry Name	Total Number of Firms in Each Industry*	Small Business Threshold: Annual Sales per Firm	Total Number of Small Businesses in Each Industry
453110	Florist	16,031	\$7 million	16,001
44711	Gasoline stations with convenience stores	44,565	\$27 million	43,724
44719	Other gasoline stations	13,195	\$14 million	12,161
446110	Pharmacies and drug stores	17,217	\$25.5 million	17,069
452910	Warehouse clubs and superstores	11	\$27 million	0
452990	All other general merchandise stores	6,946	\$30 million	6,880
72111	Hotels (except casino hotels) and motels	31,649	\$30 million	30,706
72112	Casino hotels	177	\$30 million	20
72211	Full-service Restaurants	148,269	\$7 million	142,096
722211	Limited-service restaurants	107,017	\$10 million	103,478
722212	Cafeterias, buffets, and grill buffets	4,146	\$25.5 million	4,105
722213	Snack and nonalcoholic beverage bars	24,850	\$7 million	24,449
72241	Drinking places	37,531	\$7 million	37,037

* Includes all firms in this industry, including firms that are and are not categorized as small businesses. Only firms that have been in operation for the entire year are considered as part of this analysis.

Source: U.S. Census Bureau (2007).

6.1.1.2 Affected Small Businesses

Some movement out of high-GWP refrigerants (e.g., R-404A and R-507A) has already been observed in the retail food industry, and industry pledges, such as those made by the Consumer Goods Forum and its members to phase out HFC refrigerants in newly purchased equipment by the end of 2015, may serve to accelerate the transition out of HFC refrigerants.²¹ Assuming that the industry is operating under business as usual conditions, this analysis estimates that in the absence of this rulemaking 70% of firms would continue to use R-404A or R-507A in new supermarket systems in 2017 and 70% of firms would continue to use R-404A or R-507A in new remote condensing units in 2018; therefore, these firms will be affected by this regulation. In addition, this analysis estimates that 25% of firms will have CFC-12, R-502, or HCFC-22 supermarket systems in operation in 2016 and 25% of firms will have CFC-12, R-502, or HCFC-22 remote condensing units in operation in 2016 that will be available for retrofitting. With R-404A, R-507A, or R-422D being the preferred retrofit refrigerant, firms that have CFC-12, R-502, or HCFC-22 systems in operation would thus also be affected by the regulation.

Applying these assumptions, Table 16 below presents the estimated number of small businesses expected to be directly affected by the regulatory decisions applicable to remote retail food refrigeration systems. Not all of these small businesses will be affected in the first year in which the regulation goes into effect; instead, a proportion of these businesses are expected to be affected in each of the approximately 15-20 years after 2017 or 2018, as existing supermarket systems and remote condensing units, respectively, reach end-of-life and are

²¹ The Consumer Goods Forum is a global industry network consisting of retailers, manufacturers, service providers, and other stakeholders. In 2010, the Forum agreed to “begin phasing-out hydrofluorocarbon (HFC) refrigerants as of 2015 and replace them with non-HFC refrigerants (natural refrigerant alternatives) where these are legally allowed and available for new purchases of point-of-sale units and large refrigeration installations” (CGF 2010).

replaced with new systems. Likewise a proportion of these business are expected to be affected in the years after 2016, as existing supermarket systems and remote condensing units are retrofitted.

Table 16: Estimated Number of Retail Food Small Businesses Affected by the Regulation*

NAICS Code	Industry Name	Estimated Number of Small Businesses Affected		
		New Systems	Retrofit	Total**
44511	Supermarkets and other grocery (except convenience) stores	23,332	8,333	31,665
44512	Convenience stores	11,842	4,229	16,072
44521	Specialty food stores – meat markets	3,172	1,133	4,305
44522	Specialty food stores – fish and seafood markets	1,083	387	1,470
44523	Specialty food stores – fruit and vegetable markets	1,388	496	1,884
445291	Specialty food stores – baked goods stores	1,554	555	2,109
445292	Specialty food stores – confectionary and nut stores	1,120	400	1,520
445299	All other specialty food stores	2,214	791	3,004
4453	Beer, wine, and liquor stores	15,888	5,674	21,562
453110	Florist	11,201	4,000	15,201
44711	Gasoline stations with convenience stores	30,607	10,931	41,538
44719	Other gasoline stations	8,513	3,040	11,553
446110	Pharmacies and drug stores	11,948	4,267	16,216
452910	Warehouse clubs and superstores	0	0	0
452990	All other general merchandise stores	4,816	1,720	6,536
72111	Hotels (except casino hotels) and motels	21,494	7,676	29,170
72112	Casino hotels	14	5	19
72211	Full-service Restaurants	99,467	35,524	134,992
722211	Limited-service restaurants	72,435	25,870	98,304
722212	Cafeterias, buffets, and grill buffets	2,874	1,026	3,900
722213	Snack and nonalcoholic beverage bars	17,114	6,112	23,226
72241	Drinking places	25,926	9,259	35,185
TOTAL		368,001	131,429	499,430

* Based on U.S. Census Bureau (2007); only firms that have been in operation for the entire year are considered as part of this analysis.

** The total number of firms affected is a conservative estimate given that there is likely overlap in the firms who are assumed to be affected by the regulatory decisions concerning new systems and the regulatory decisions concerning refrigerant retrofits.

6.1.2 Stand-Alone Retail Food Equipment

Stand-alone retail food refrigerators and freezers are commonly located in supermarkets, warehouse clubs/superstores, convenience stores, restaurants, bars, cafeterias, hotels, schools, hospitals. These systems integrate all components within their structure, and can be further characterized by their operating temperature (e.g., medium vs. low), door type (e.g., transparent, solid, without), and orientation (e.g., horizontal, semivertical, vertical). These units are distinct from other commercial refrigeration equipment designed to make or process cold food and beverages that are dispensed via a nozzle, including soft-serve ice cream machines, “slushy” iced beverage dispensers, and soft-drink dispensers.

6.1.2.1 Affected Industries

Manufacturers of new stand-alone equipment using an alternative refrigerant to the ones listed by this regulation as unacceptable are assumed to incur costs associated with that alternative. With regard to retrofitting, 3% of stand-alone equipment is assumed to have CFC-12, R-502, or HCFC-22 in operation by 2016 that would be available for retrofitting (based on EPA's Vintaging Model). However, it is assumed that end-users do not and would not retrofit this equipment, even in the absence of the rulemaking, due to the high costs of retrofitting equipment relative to the cost of purchasing a new unit. As a result, only manufacturers (and no end-users) of stand-alone equipment are identified as being affected by this regulation.

Manufacturers of stand-alone units have been identified by the Department of Energy (DOE) in support of rulemakings for the Appliance and Equipment Standards Program. Based on the DOE's assessment, there are a total of 33 commercial refrigeration equipment manufacturers (DOE 2013). Industry data for commercial refrigeration equipment is matched to NAICS code 333415, *air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing*. The small business threshold for this industry is defined as enterprises with 750 employees or fewer. Based on this, DOE identified a total of 30 commercial refrigeration equipment manufacturers that are small businesses.

6.1.2.2 Affected Small Businesses

Like the remote retail food equipment subsector, developments in the stand-alone retail food equipment industry suggest that some companies are already planning to transition out of HFCs. Recent SNAP approvals for alternative refrigerants used in stand-alone retail food systems (e.g., propane, carbon dioxide, and R-450A, found acceptable or acceptable subject to use conditions in 2011, 2009, and 2014 respectively) give companies additional options for transition. In addition, industry pledges to phase out HFCs (e.g., the Consumer Goods Forum's pledge to phase out HFC refrigerants in newly purchased equipment by the end of 2015) may create momentum in the transition away from HFCs.

However, due to the higher cost estimate of transitioning to an alternative (as discussed further below), for the purposes of this analysis, it is conservatively assumed that no small businesses will make this transition in the absence of the regulation. As a result, in the absence of the regulation it is assumed that all small businesses would continue to use R-404A or HFC-134a in new stand-alone equipment, and thus will be affected by the regulation.

Table 17 below summarizes the estimated number of small businesses expected to be directly affected by the regulatory decision applicable to new stand-alone equipment. As previously noted, no end-users of stand-alone units are expected to be affected by this regulation.

Table 17: Estimated Number of Stand-Alone Retail Food Equipment Manufacturing Small Businesses Affected by the Regulation

NAICS Code	Industry Name	Estimated Number of Small Businesses Affected
333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	30

6.1.3 Vending Machines

Vending machines are commonly located in offices, public locations, and factories. Similar to stand-alone systems, vending machines can be further characterized by their operating temperature (e.g., medium vs. low), machine use designation (e.g., indoor vs. indoor/outdoor), and front type (e.g., glassfront vs. solid-door).

6.1.3.1 Affected Industries

Manufacturers of new vending machines using an alternative refrigerant to the ones listed by this regulation as unacceptable are expected to incur costs associated with that alternative. With regard to retrofitting, based on the lifetime of the equipment and the direct transition from CFCs to HFCs in this end-use before 1996, the analysis assumes that no vending machines will have CFC-12, R-502, or HCFC-22 systems in operation in 2016 that would be available for retrofitting. As a result, only manufacturers (and no end-users) of vending machines are identified as being affected by this regulation.

Manufacturers of vending machines have been identified by the Department of Energy (DOE) in support of rulemakings for the Appliance and Equipment Standards Program. Based on the DOE's assessment, there are a total of 10 manufacturers of beverage vending machines (DOE 2008). No data are available on the number of manufacturers of other (non-beverage) refrigerated vending machines, although reports suggest that beverage vending machines represent the majority of the refrigerated vending machine market (DOE 2009). Industry data for vending machine is matched to NAICS code 333311, *automatic vending machine manufacturing*. The small business threshold defines small business manufacturing enterprises for automatic vending machine manufacturing as those having 500 employees or fewer. Based on this, DOE (2008) identified a total of six beverage vending machine manufacturers that are small businesses. Applying the conservative assumption that beverage vending machines represent half of the total refrigerated vending machine market, it is assumed that 12 small-business refrigerated vending machine manufacturers could be affected by the rulemaking.²²

6.1.3.2 Affected Small Businesses

Similar industry trends to those already noted for retail food—i.e., the approval of carbon dioxide by SNAP for use in vending machines in 2012 and voluntary industry efforts by companies such as Coca-Cola and Pepsi Co to transition away from HFCs in vending machines (CGF 2010)—may serve to accelerate the transition out of HFC refrigerants. Assuming that the industry is operating under business as usual conditions, in the absence of the regulation it is assumed that 40% of the market would already have transitioned to an alternative refrigerant in

²² DOE (2009) indicates that beverage vending machines represent 50-90% of the refrigerated vending machine market. For the purposes of this analysis, it is assumed that the number of small business beverage vending machine manufacturers is proportional to the market share of beverage vending machines. Therefore, it is estimated that the total number of small business refrigerated vending machine manufacturers could range from seven to 12 small businesses.

new equipment by 2018. As a result, it is estimated that 60% of the small businesses identified by DOE (2009) (equivalent to seven small businesses) will be affected by this regulation.

Table 18 below summarizes the estimated number of small businesses expected to be directly affected by the regulatory decision applicable to new vending machines. As already stated, no end-users of vending machines are expected to be affected by this regulation.

Table 18: Estimated Number of Vending Machine Manufacturing Small Businesses Affected by the Regulation

NAICS Code	Industry Name	Estimated Number of Small Businesses Affected
333311	Automatic vending machine manufacturing	7

6.2 Estimated Economic Impact on Affected Small Entities

For each end use, the potential economic impact on small businesses was calculated by comparing the estimated annualized compliance cost to average annual sales per firm (i.e., sales test).

6.2.1 Remote Retail Food Equipment (Supermarket Systems and Remote Condensing Units)

For modeling purposes, compliance costs were based on the assumption that end-users would use R-407A in new and retrofitted systems in place of R-404A and R-507A. The incremental cost of using this alternative is assumed to be negligible (i.e., zero dollars) based on cost assumptions identified in EPA’s report on *Global Mitigation of Non-CO₂ Greenhouse Gases: 2010-2030* (EPA 2013). As presented in Table 19, since annualized compliance costs of using alternative refrigerants are assumed to be negligible, annual compliance costs as a percentage of average annual sales per firm are assumed to be zero.²³

²³ EPA (2013) assumes that there is a one-time conversion cost associated with performing a refrigerant retrofit on a remote retail food system. However, since the rulemaking does not require end-users to retrofit their equipment, but rather only prohibits the use of certain refrigerants to be used as a retrofit, the labor costs associated with performing the retrofit itself are not associated with the rulemaking and therefore not included in this analysis.

Table 19: Estimated Economic Impact on Small Entities with Remote Retail Food Equipment (Sales Test)

NAICS Code	Industry Name	Annual Compliance Cost as a Percentage of Average Annual Sales per Firm
44511	Supermarkets and other grocery (except convenience) stores	0%
44512	Convenience stores	0%
44521	Specialty food stores – meat markets	0%
44522	Specialty food stores – fish and seafood markets	0%
44523	Specialty food stores – fruit and vegetable markets	0%
445291	Specialty food stores – baked goods stores	0%
445292	Specialty food stores – confectionary and nut stores	0%
445299	All other specialty food stores	0%
4453	Beer, wine, and liquor stores	0%
453110	Florist	0%
44711	Gasoline stations with convenience stores	0%
44719	Other gasoline stations	0%
446110	Pharmacies and drug stores	0%
452910	Warehouse clubs and superstores	0%
452990	All other general merchandise stores	0%
72111	Hotels (except casino hotels) and motels	0%
72112	Casino hotels	0%
72211	Full-service Restaurants	0%
722211	Limited-service restaurants	0%
722212	Cafeterias, buffets, and grill buffets	0%
722213	Snack and nonalcoholic beverage bars	0%
72241	Drinking places	0%

6.2.2 Stand-Alone Retail Food Equipment

For the regulatory decisions that affect stand-alone retail food equipment, the potential economic impact on small businesses was calculated based on the assumption that all manufacturers of stand-alone equipment would use hydrocarbons (R-290) or a non-flammable low-GWP refrigerant blend (e.g., R-450A) in place of HFC refrigerants in new equipment.

Specifically, for manufacturers of self-contained refrigerators/freezers, it is assumed that there is a one-time investment of \$150,000 to \$500,000 associated with using R-290 or a non-flammable alternative in place of an HFC refrigerant. This estimate is based on industry input, which assumes the need for manufacturers to (a) purchase new charging equipment, (b) test and certify their equipment to UL standards, and (c) convert their facility to accommodate a flammable refrigerant, if applicable (e.g., installing sensors and storage capacity). No incremental manufacturing costs are assumed given that the cost to consumers of R-290 self-contained systems is on par with the cost of systems that contain an HFC (EPA 2013). Systems that use R-450A—a refrigerant blend of HFC-134a and HFO-1234ze(E)—are also expected to have similar costs to HFC-134a and R-404A systems.

For manufacturers of stand-alone units affected by this regulation, average annual sales per establishment were calculated by dividing total value of shipments (as a proxy for sales) by the number of establishments, for each

small business establishment size (e.g., 0-4 employees, 5-9 employees, 10-19 employees, etc.). Because average annual sales were calculated by establishment size, a range is provided for annual compliance costs as a percentage of annual sales. In general, annual compliance costs represent a higher percentage of annual sales for smaller establishments. Table 20 below presents the estimated economic impact of this regulation on small businesses in the stand-alone retail food refrigeration category.

Table 20: Estimated Economic Impact on Small Entities in the Stand-Alone Retail Food Category (Sales Test)

NAICS Code	Industry Name	Annual Compliance Cost as a Percentage of Average Annual Sales per Firm
333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	<0.1%–11.5%

6.2.3 Vending Machines

For the regulatory decisions that affect vending machines, the potential economic impact on small businesses was calculated based on the assumption that all manufacturers of vending machines would use carbon dioxide in place of HFC refrigerants in new equipment. Specifically, for vending machine manufacturers, it is assumed that there is a one-time investment cost of \$100,000 to \$250,000 associated with using carbon dioxide in place of HFC refrigerants. This cost is assumed to be required for the purchase of new equipment to support the testing, certification, and manufacture of vending machines that contain carbon dioxide.²⁴

For manufacturers of vending machines affected by this regulation, average annual sales per establishment were calculated by dividing total value of shipments (as a proxy for sales) by the number of establishments, for each small business establishment size (e.g., 0-4 employees, 5-9 employees, 10-19 employees, etc.). Because average annual sales were calculated by establishment size, a range is provided for annual compliance costs as a percentage of annual sales. In general, annual compliance costs represent a higher percentage of annual sales for smaller establishments. Table 21 below presents the estimated economic impact of this regulation on small businesses in the vending machine end-use.

Table 21: Estimated Economic Impact on Small Entities in the Vending Machine End-Use (Sales Test)

NAICS Code	Industry Name	Annual Compliance Cost as a Percentage of Average Annual Sales per Firm
333311	Automatic vending machine manufacturing	<0.1%–9.1%

²⁴ These costs may be partially offset by cost pass-through to the consumer. One report indicated that vending machines that are charged with carbon dioxide cost 2-3%, or roughly \$100, more than vending machines that are charged with HFCs (DOE 2009).

7 Conclusion

This screening analysis finds that the final rulemaking can be presumed to have ***no significant economic impact on a substantial number of small entities (SISNOSE)***, as described below. The discussion below describes the decision matrix used to make this determination, as well as the aggregated small business impacts.

7.1 Decision Regarding Significant Economic Impact on a Substantial Number of Small Entities

Using economic threshold levels set conservatively at 1% and 3% of sales, consistent with similar analyses on other Title VI rules, this screening analysis finds that the rulemaking can be presumed to have ***no SISNOSE***. These thresholds are set conservatively because the rulemaking affects small businesses in a range of different industries, which may have significantly different profit margins and abilities to pass compliance costs along to customers.

7.2 Aggregated Small Business Impacts of Regulatory Changes

Table 22 summarizes the total number of small businesses that are expected to be subject to the regulation, as well as the total economic impact on those small businesses using a 7% discount rate.

Table 23 summarizes the total number of small businesses that are expected to be subject to the regulation, as well as the total economic impact on those small businesses using a 3% discount rate.

As shown, an estimated 500,000 small businesses may be subject to the regulatory actions, the vast majority of which are not expected to experience adverse economic impacts. Nearly all of the small businesses are in the commercial refrigeration sector. The foam sector is expected to account for nearly all of total annualized compliance costs experienced by small businesses; although these costs would be borne by about 120 small businesses, the average sales per small business are relatively high in this industry, keeping costs for the majority of those foam manufacturers below 1% of annual sales.

Table 22: Summary of the Small Business Impact at 7% Discount Rate

Sector	NAICS	Industry	Estimated Number of Small Businesses Affected by the Rule	Total Annualized Economic Impact on Small Businesses	
				Lower	Higher
MVACs	336111	Automobile Manufacturing	0	\$0	\$0
	336112	Light truck and utility vehicle manufacturing	0	\$0	\$0
Aerosols	325620	Perfumes, Makeups and Other Toiletries	-	\$0	\$0
	325612	Polishes and Other Sanitation Goods	-	\$0	\$0
	325520	Adhesive manufacturing	-	\$0	\$0
	324191	Petroleum lubricating oil and grease manufacturing	-	\$0	\$0
	325510	Paint and Coating Manufacturing	-	\$0	\$0
	325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing	5	-\$360,000	\$90,000

	325412	Pharmaceutical Preparation Manufacturing	-	\$0	\$0
	325199	All Other Basic Organic Chemical Manufacturing	-	\$0	\$0
	339113	Surgical Appliance & Supplies Manufacturing	-	\$0	\$0
Foams	326140	Polystyrene foam product manufacturing	-	\$0	\$0
	335222	Household refrigerator and home freezer manufacturing	5	\$590,000	\$910,000
	333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	47	-\$70,000	\$510,000
	326150	Urethane and other foam product (except polystyrene) manufacturing	61	\$3,840,000	\$4,620,000
Retail Food	44511	Supermarkets and Other Grocery (Except Convenience) Stores	31,665	\$0	\$0
	44512	Convenience Stores	16,072	\$0	\$0
	44521	Specialty Food Stores – Meat Markets	4,305	\$0	\$0
	44522	Specialty Food Stores – Fish & Seafood Markets	1,470	\$0	\$0
	44523	Specialty Food Stores – Fruit & Vegetable Markets	1,884	\$0	\$0
	445291	Specialty Food Stores – Baked Goods Stores	2,109	\$0	\$0
	445292	Specialty Food Stores – Confectionary & Nut Stores	1,520	\$0	\$0
	445299	All Other Specialty Food Stores	3,004	\$0	\$0
	4453	Beer, Wine, & Liquor Stores	21,562	\$0	\$0
	453110	Florist	15,201	\$0	\$0
	44711	Gasoline Stations with Convenience Stores	41,538	\$0	\$0
	44719	Other Gasoline Stations	11,553	\$0	\$0
	446110	Pharmacies and Drug Stores	16,216	\$0	\$0
	452910	Warehouse Clubs and Superstores	-	\$0	\$0
	452990	All Other General Merchandise Stores	6,536	\$0	\$0
	72111	Hotels (Except Casino Hotels) & Motels	29,170	\$0	\$0
	72112	Casino Hotels	19	\$0	\$0
	72211	Full-Service Restaurants	134,992	\$0	\$0
	722211	Limited-Service restaurants	98,304	\$0	\$0
	722212	Cafeterias, Buffets, & Grill Buffets	3,900	\$0	\$0
	722213	Snack & Nonalcoholic Beverage Bars	23,226	\$0	\$0
	72241	Drinking Places	35,185	\$0	\$0
	333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	30	\$420,000	\$1,420,000
	333311	Automatic Vending Machine Manufacturing	7	\$70,000	\$170,000
TOTAL*			499,784	\$4,490,000	\$7,720,000

*Total may not sum due to rounding.

Table 23: Summary of the Small Business Impact at 3% Discount Rate

Sector	NAICS	Industry	Estimated Number of Small Businesses Affected by the Rule	Total Annualized Economic Impact on Small Businesses	
				Lower	Higher
MVACs	336111	Automobile Manufacturing	0	\$0	\$0
	336112	Light truck and utility vehicle manufacturing	0	\$0	\$0
Aerosols	325620	Perfumes, Makeups and Other Toiletries	-	\$0	\$0
	325612	Polishes and Other Sanitation Goods	-	\$0	\$0
	325520	Adhesive manufacturing	-	\$0	\$0
	324191	Petroleum lubricating oil and grease manufacturing	-	\$0	\$0
	325510	Paint and Coating Manufacturing	-	\$0	\$0
	325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing	5	-\$390,000	-\$20,000
	325412	Pharmaceutical Preparation Manufacturing	-	\$0	\$0
	325199	All Other Basic Organic Chemical Manufacturing	-	\$0	\$0
	339113	Surgical Appliance & Supplies Manufacturing	-	\$0	\$0
Foams	326140	Polystyrene foam product manufacturing	-	\$0	\$0
	335222	Household refrigerator and home freezer manufacturing	5	\$240,000	\$490,000
	333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	47	-\$800,000	-\$370,000
	326150	Urethane and other foam product (except polystyrene) manufacturing	61	\$2,870,000	\$3,460,000
Retail Food	44511	Supermarkets and Other Grocery (Except Convenience) Stores	31,665	\$0	\$0
	44512	Convenience Stores	16,072	\$0	\$0
	44521	Specialty Food Stores – Meat Markets	4,305	\$0	\$0
	44522	Specialty Food Stores – Fish & Seafood Markets	1,470	\$0	\$0
	44523	Specialty Food Stores – Fruit & Vegetable Markets	1,884	\$0	\$0
	445291	Specialty Food Stores – Baked Goods Stores	2,109	\$0	\$0
	445292	Specialty Food Stores – Confectionary & Nut Stores	1,520	\$0	\$0
	445299	All Other Specialty Food Stores	3,004	\$0	\$0
	4453	Beer, Wine, & Liquor Stores	21,562	\$0	\$0
	453110	Florist	15,201	\$0	\$0
	44711	Gasoline Stations with Convenience Stores	41,538	\$0	\$0
	44719	Other Gasoline Stations	11,553	\$0	\$0
	446110	Pharmacies and Drug Stores	16,216	\$0	\$0
	452910	Warehouse Clubs and Superstores	-	\$0	\$0

	452990	All Other General Merchandise Stores	6,536	\$0	\$0
	72111	Hotels (Except Casino Hotels) & Motels	29,170	\$0	\$0
	72112	Casino Hotels	19	\$0	\$0
	72211	Full-Service Restaurants	134,992	\$0	\$0
	722211	Limited-Service restaurants	98,304	\$0	\$0
	722212	Cafeterias, Buffets, & Grill Buffets	3,900	\$0	\$0
	722213	Snack & Nonalcoholic Beverage Bars	23,226	\$0	\$0
	72241	Drinking Places	35,185	\$0	\$0
	333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	30	\$300,000	\$1,010,000
	333311	Automatic Vending Machine Manufacturing	7	\$50,000	\$120,000
TOTAL*			499,784	\$2,280,000	\$4,700,000

*Total may not sum due to rounding.

Table 24 aggregates the estimated economic impacts on small businesses, according to the categories set out in the SISNOSE decision matrix. For the most conservative assessment, Table 24 reflects the higher cost ranges for each end-use and a 7% discount rate. Using the decision criteria established in this screening analysis suggests that this rulemaking can be presumed to have **no SISNOSE** for the following reasons:

- More than 99% of small businesses subject to this rulemaking would be expected to experience zero compliance costs.
- For about 120 small businesses that are expected to incur compliance costs as a result of this rulemaking, their costs are estimated to be less than 1% of annual sales.
- This analysis indicates that fewer than 80 of the nearly 500,000 affected small businesses—or <0.1%—could incur costs in excess of 1% of annual sales, and that fewer than 60 small businesses could incur costs in excess of 3% of annual sales. These estimates are below the thresholds for a substantial number determination (i.e., fewer than 100 businesses, and less than 20% of affected entities).

Table 24: Aggregated Economic Impacts on Small Businesses

Economic Impact	Industry Impacted		Number of Small Entities Subject to the Rule and Experiencing Given Economic Impact	Percent of All Small Entities Subject to the Rule That are Experiencing Given Economic Impact
Less than 1% for all affected small entities ^a	335222	Household refrigerator and home freezer manufacturing	5	0.02%
	326150	Urethane and other foam product (except polystyrene) manufacturing	36	
	333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	71	
	333311	Automatic Vending Machine Manufacturing	7	
		Total	120	
1% or more for one or more affected small entities ^b	325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing	3	0.01%
	326150	Urethane and other foam product (except polystyrene) manufacturing	26	
	333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	38	
	333311	Automatic Vending Machine Manufacturing	7	
		Total	74	
Greater than 3% for one or more affected small entities	326150	Urethane and other foam product (except polystyrene) manufacturing	17	0.01%
	333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	33	
	333311	Automatic Vending Machine Manufacturing	7	
		Total	57	

Totals may not sum due to independent rounding.

^a Represents small entities affected with an economic impact equal to or lesser than 1% but greater than 0%.

^b This category aggregates the number of small entities that would be expected to experience an impact of 1% to 3% with the number of small entities that would be expected to experience an impact of 3% or greater.

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