Climate Benefits of the SNAP Program Status Change Rule

July 2015

U.S. Environmental Protection Agency
Stratospheric Protection Division
Office of Atmospheric Programs
Office of Air and Radiation

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Executive Summary

The U.S. Environmental Protection Agency (EPA) is issuing a final rule that changes the status of certain alternatives[1] previously found acceptable under the Significant New Alternatives Policy (SNAP) program. The EPA is modifying the listings from acceptable to unacceptable for certain hydrofluorocarbons (HFCs) and HFC blends in aerosol, foam blowing, air conditioning, and refrigeration end-uses where other alternatives are available or potentially available that pose overall lower risk to human health and the environment. The emissions avoided associated with the final rule are estimated to be 26 to 31 million metric tons (i.e., teragrams) of carbon dioxide equivalent ($MMTCO_2eq$) in 2020 and 54 to 64 $MMTCO_2eq$ in 2025.

Background

In June 2013, the President announced the Climate Action Plan (CAP) stating that "while no single step can reverse the effects of climate change, we have a moral obligation to future generations to leave them a planet that is not polluted and damaged. Through steady, responsible action to cut carbon pollution, we can protect our children's health and begin to slow the effects of climate change so that we leave behind a cleaner, more stable environment."[2] Among the many actions called for, the CAP outlined a set of measures to address hydrofluorocarbons (HFCs). In the United States, emissions of HFCs are expected to double from current levels of 1.5 percent of greenhouse gas (GHG) emissions to 3 percent by 2020 and nearly triple by 2030.[3] HFCs are rapidly accumulating in the atmosphere. For example, the atmospheric concentration of HFC-134a, the most abundant HFC, has increased by about 10% per year from 2006 to 2012, and the concentrations of HFC-143a and HFC-125 rose over 13% and 16% per year, respectively, from 2007 to 2011.[4,5]

The President directed the executive branch of the United States government to lead through both international diplomacy and domestic action in addressing HFCs. In particular, he directed the EPA to use its authority through the Significant New Alternatives Policy (SNAP) Program to "encourage private sector investment in low-emissions technology by identifying and approving climate-friendly chemicals while prohibiting certain uses of the most harmful chemical alternatives."[6]

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[1] For purposes of this document, the terms "substitutes" and "alternatives" are used interchangeably.
[2] The President's Climate Action Plan, Executive Office of the President, June 2013. Available at http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf
[3] Ibid.
[4] Montzka, S.A.: HFCs in the Atmosphere: Concentrations, Emissions and Impacts, ASHRAE/NIST Conference 2012
[5] NOAA data at ftp://ftp.cmdl.noaa.gov/hats/hfcs/
[6] The President's Climate Action Plan, Executive Office of the President, June 2013, page 10. Available at http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf

Under the authority of section 612 of the Clean Air Act, the EPA is both expanding the list of acceptable alternatives and also changing the status of certain alternatives from acceptable to unacceptable. The analysis presented here concerns the EPA's final action to modify the listings from acceptable to unacceptable for certain HFCs and HFC blends in aerosol, foam blowing, air conditioning, and refrigeration end-uses where other alternatives are available or potentially available that pose less overall risk to human health and the environment. The agency considers the intersection between the specific HFC or HFC blend and the particular end-use. In this action, the EPA is not listing any specific HFCs as unacceptable across all sectors and end-uses, nor is the EPA determining, for any specific sector, that no HFCs are acceptable substitutes. The EPA recognizes that both fluorinated substitutes (e.g., HFCs, hydrofluoroolefins (HFOs)) and non-fluorinated substitutes (e.g., hydrocarbons (HCs), carbon dioxide (CO_2)) can be used. Thus, consistent with Clean Air Act (CAA) Section 612, the existing SNAP regulations, and historical practice under the SNAP program, the EPA has considered the intersection among each substitute being evaluated, the particular end-use, the SNAP criteria for evaluation, and the current suite of other available and potentially available substitutes in each particular end-use.

Analysis of Climate Benefits

The EPA's SNAP Program, pursuant to Section 612 of the Clean Air Act, evaluates whether substitutes are safer overall for human health and the environment than other available substitutes. For each end use, SNAP lists substitutes as either acceptable, acceptable subject to use conditions, acceptable subject to narrowed use limits, or unacceptable. SNAP's evaluation of the overall safety of a substitute considers its toxicity, flammability, ozone depletion potential, and global warming potential (GWP), among other factors. The CAP directs the EPA to use the SNAP Program to encourage private sector investment in low-emissions technology by identifying and approving climate-friendly chemicals while prohibiting certain uses of the most harmful chemical alternatives. To this end, SNAP's Status Change Rule changes the listing of certain alternatives in the foams, commercial refrigeration, aerosols, and motor vehicle air-conditioning (MVAC) sectors from acceptable to unacceptable, from acceptable to acceptable subject to use conditions, or from acceptable to acceptable subject to narrowed use limits. The specific listing changes for each end use can be found in Table 2.

Methodology

To estimate the climate benefits of the rule, the EPA compared a business-as-usual (BAU) forecast of HFC emissions with those derived under various scenarios conforming to the rule. In developing both the BAU forecast and the scenarios, the EPA used its Vintaging Model,[7] an emission estimation tool used to derive HFC emission inventories for reporting to the Intergovernmental Panel on Climate Change (IPCC) as part of the United States' obligations under the United Nations Framework Convention on Climate Change (UNFCCC).

[7] VM IO file_v4.4_12.16.09_GER_IMAC_Domestic_2013 Options Update_AR4_6-19-15.xlsm

The Vintaging Model was developed as a tool for estimating the annual chemical emissions from industrial sectors that have historically used ODS in their products. Under the terms of *The Montreal Protocol on Substances that Deplete the Ozone Layer* and the Clean Air Act, the production and import of ODS have been greatly reduced, motivating these industrial sectors to transition to more ozone-friendly chemicals. As these industries have moved toward ODS alternatives, including HFCs, the Vintaging Model has evolved into a tool for estimating the rise in emissions of these alternatives and the decline of ODS emissions.

The Vintaging Model estimates emissions from five ODS and ODS-substitute end-use sectors: air-conditioning and refrigeration, foams, aerosols, solvents, and fire-extinguishing. Within these sectors, there are 60 independently modeled end-uses. The model requires information on the market growth for each of the end-uses, a history of the market transition from ODS to alternatives, and the characteristics of each end-use such as market size or charge sizes and loss rates. As ODS are phased out, a percentage of the market share originally filled by the ODS is allocated to each of its substitutes.

The model, named for its method of tracking the emissions of annual "vintages" of new equipment that enter into service, is a "bottom-up" model. It models the emissions of ODS and ODS substitutes based on estimates of the quantity of equipment or products sold, serviced, and retired each year; the amount of the chemical required to manufacture and/or maintain the equipment; and the amount emitted during specific time periods. The Vintaging Model makes use of this market information to build an inventory of the in-use stocks of the equipment and ODS and ODS substitute(s) in each of the end-uses. The simulation is considered to be a BAU baseline case, and it does not incorporate measures to reduce or eliminate the emissions of these gases other than those currently required by statute or regulation, or otherwise common in the industry. Emissions are estimated by applying annual leak rates, service emission rates, and disposal emission rates to each population of equipment. By aggregating the emission output from the different end-uses, the model produces estimates of total annual emissions of each chemical.

The Vintaging Model synthesizes data from a variety of sources, including data from the ODS Tracking System maintained by the EPA's Stratospheric Protection Division and information from submissions to the EPA under the SNAP program. Published sources include documents prepared by the United Nations Environment Programme (UNEP) Technical Options Committees, reports from the Alternative Fluorocarbons Environmental Acceptability Study (AFEAS), and conference proceedings from the International Conferences on Ozone Protection Technologies and Earth Technologies Forums. The EPA also coordinates extensively with numerous trade associations and individual companies. For example, the Alliance for Responsible Atmospheric Policy; the Air-Conditioning, Heating and Refrigeration Institute; the Association of Home Appliance Manufacturers; the American Automobile Manufacturers Association; and many of their member companies have provided valuable information over the years.

Because the Vintaging Model follows a bottom-up approach, scenarios of alternate pathways may be developed by changing transition timing, chemical(s) chosen, and emission patterns. For example, because the final rule does not allow certain HFCs to be used in certain end-uses, a scenario can be run in the Vintaging Model that assumes that a particular end-use transitions to an alternative that would remain acceptable. As a specific example, the scenario may assume some or all new supermarket systems

(within the Vintaging Model end-use "Large Retail Food") utilize R-407A or R-407F rather than R-404A, R-507A and other chemicals which are being listed as unacceptable in that end-use. That scenario could vary in timing; for instance, by assuming this transition only begins in 2017 or by assuming it starts earlier, with some new supermarkets utilizing R-407A or R-407F in 2015, more in 2016, and all in 2017. Either such transition would be in compliance with the final rule assuming the transition is complete by the required date. Likewise, a scenario could assume transition to new low-GWP refrigerant blends that have been listed as acceptable under the SNAP program for that end-use, such as R-448A.

To analyze the potential emissions reductions of the final rule, scenarios were developed to estimate the rate at which transition away from higher-GWP HFCs would progress and what would be used in place of the higher-GWP HFCs. The analysis includes three scenarios for comparison: the most likely transition scenario; a higher, more aggressive transition scenario; and a lower, less aggressive transition scenario.[8] The scenarios differ in their assumptions on transition away from high-GWP HFCs in four ways:

- earlier/later start of transitions,
- faster/slower rise to saturation,
- higher/lower saturation level, and
- higher/lower preference for lower GWPs in end-uses where the options analyzed vary.

The U.S. emissions of HFCs from each end-use were estimated for these scenarios and the baseline scenario (i.e., BAU scenario without the rule) using the EPA's Vintaging Model, and the total GWP-weighted emissions and emission reductions were calculated in $MMTCO_2eq$ as shown below in Table 1 and Figure 1.[9] The version of the Vintaging Model used is consistent with previous EPA analyses of non-CO_2 GHG abatement options.[10]

Climate Benefits

As shown in Table 1, implementation of the Status Change Rule is estimated to reduce net HFC emissions in 2020 by 26 to 31 $MMTCO_2eq$ and 54 to 64 $MMTCO_2eq$ in 2025. The most likely transition scenario was developed based on EPA experience in the sectors and knowledge of the available, SNAP-acceptable alternatives that are currently being tested and implemented. The estimates for all three scenarios exclude domestic climate benefits from transitions in the light-duty motor vehicles sector because they

[8] The scenarios analyzed here reflect possible transitions for compliance based on considerations of the market and activity towards lower-GWP solutions. A separate technical support document analyzes the cost of complying with the final rule using a different transition scenario that looks at the lower-cost options of available technologies. Higher or lower climate benefits do not necessarily correlate to higher or lower costs due to the different assumptions and methodologies used in the different analyses. However, the transitions assumed in the lower, less aggressive scenario here are similar to the transitions assumed in the cost analysis.

[9] GWPs used are direct, 100-year values from IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Where GWPs are not available from that source, values are taken from the literature as referenced in the SNAP decisions first listing such substances as acceptable.

[10] *Global Mitigation of Non-CO_2 Greenhouse Gases: 2010–2030* (EPA Report 430-R-13-011, September 2013)

are accounted for under separate EPA analysis.[11] However, this analysis includes an element for MVAC exports not included in domestic climate benefits under that separate analysis.

In 2013, exports made up about 25% of U. S. passenger car vehicle production and about 19% of light-duty truck production;[12] thus, for this analysis 20% was assumed as a conservative estimate to calculate the export-only MVAC emissions reductions. Of the 20% export segment, 48% were considered for benefits of this rule because 52% of U.S. exports in 2013 were to countries that either have policies in place or under consideration that would prohibit the use of HFC-134a in light-duty vehicle air conditioning either at the same time as this rule or before model year 2021. Also, to reflect the narrowed use provisions in the final rule for exports of MVAC systems to countries lacking infrastructure to service systems with certain alternative refrigerants, the rate of market penetration was adjusted in the scenarios run within the Vintaging Model.

Table 1. U.S. Emissions Profile in Transition Scenarios and Baseline

Year	2010	2015	2020	2025	2030
	($MMTCO_2eq$)				
U. S. Emissions Baseline	149	215	285	373	420
Estimated Emissions from Higher Scenario	149	214	254	309	319
Estimated Emission Reductions from Higher Scenario	**-**	***1***	***31***	***64***	***101***
Estimated Emissions from Most Likely Scenario	149	212	256	313	328
Estimated Emissions Reductions from Most Likely Scenario	**-**	***3***	***29***	***60***	***92***
Estimated Emissions from Lower Scenario	149	212	259	319	342
Estimated Emissions Reductions from Lower Scenario	**-**	***3***	***26***	***54***	***78***

The estimated emission reductions in 2020 of 29 $MMTCO_2eq$ for all sectors using the most likely transition scenario can be seen in Figure 1 below. The largest emissions reductions are estimated to come from the commercial refrigeration sector at approximately 25 $MMTCO_2eq$, primarily from the reduced annual emissions of higher-GWP refrigerants from new supermarkets that adopt lower-GWP options in 2020 and the preceding years. The other emission reduction estimates by sector are from foams at 3 $MMTCO_2eq$; export only MVACs at 1 $MMTCO_2eq$; and consumer aerosols at 0.5 $MMTCO_2eq$. Table 2 provides the listing changes in the SNAP status change rule by end-use that were analyzed.

[11] See Chapter 7 of the Regulatory Impact Analysis: Final Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, EPA-420-R-12-016, August 2012.
[12] U. S. Department of Commerce, Bureau of Economic Analysis Supplemental Estimates: Motor Vehicles http://www.bea.gov/national/index.htm

Figure 1. Most Likely Scenario Emissions Reductions by Sector in 2020 ($MMTCO_2eq$)

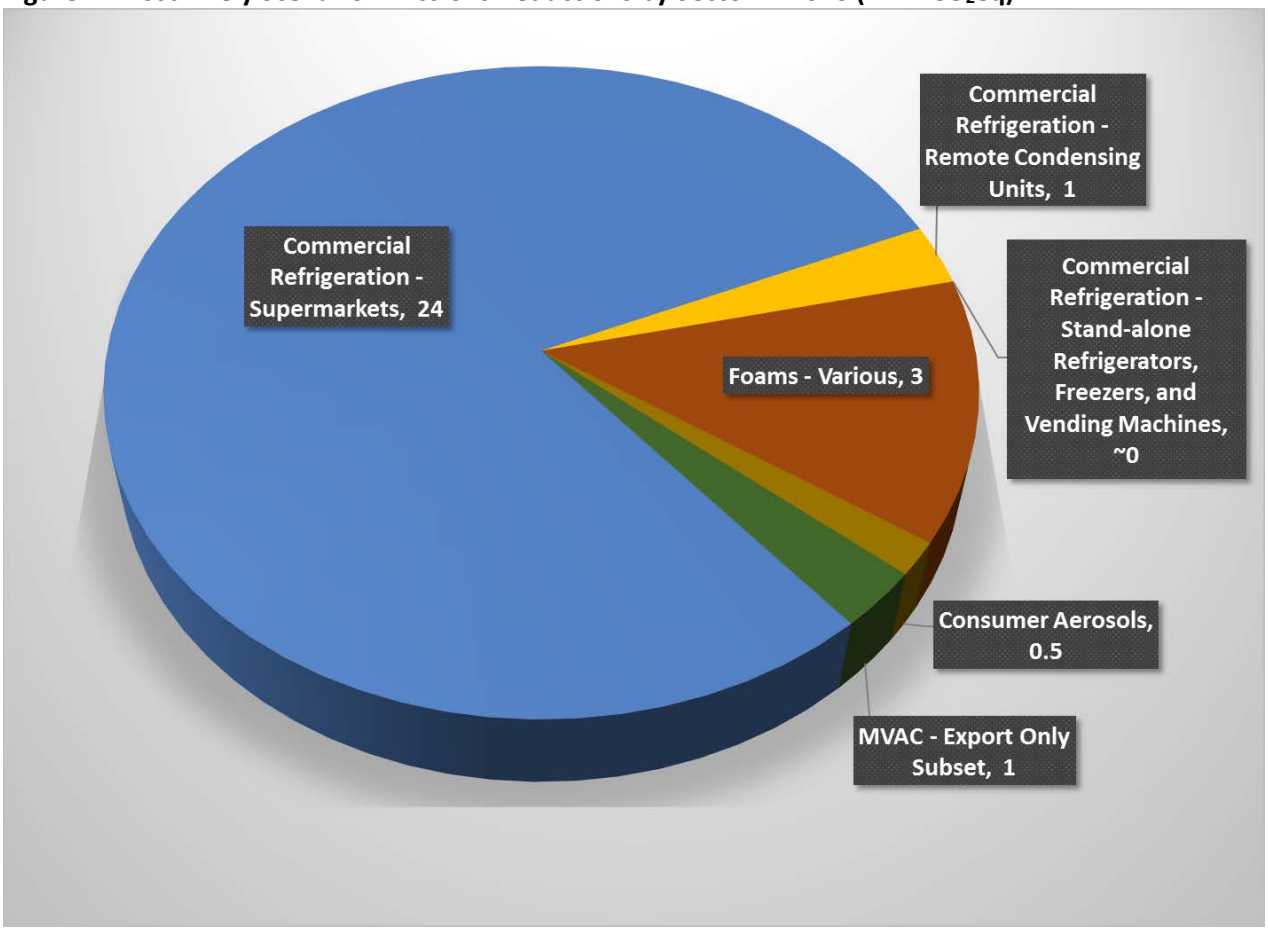


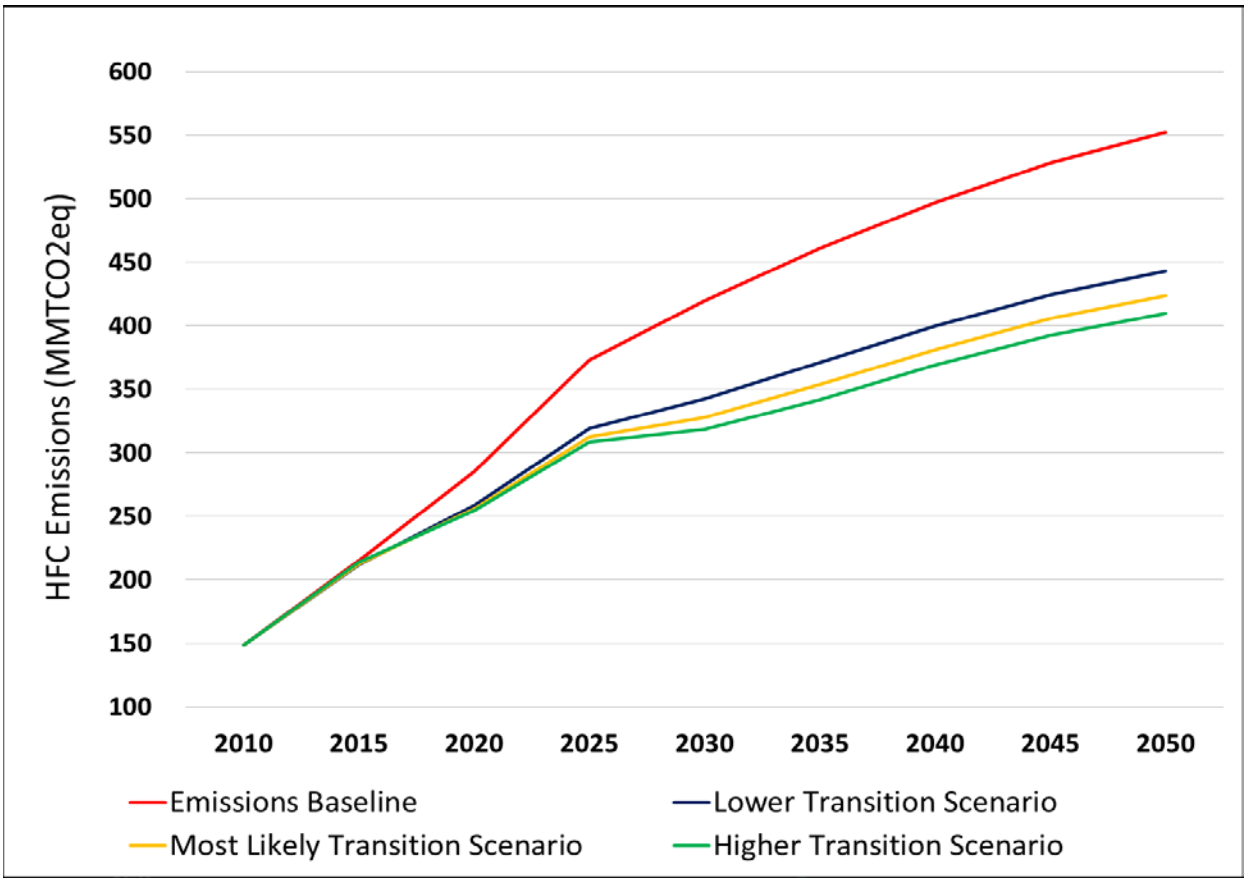
Table 2: Listing Changes in the SNAP Status Change Rule by End Use

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.

Sector	Description of Regulatory Change
	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.
	Narrowed use limits apply until 2022 for military or space and aeronautics applications in all foams end-uses where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements.
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.
	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.
	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 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 medium-temperature units 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.

By 2020, most of the provisions in the final rule will be in effect.[13] The differences in the three scenarios in 2020 and other years are significant mostly because of the lag between when alternatives are introduced in new motor vehicle air conditioners, refrigeration equipment, and foams, and when the emission reductions are realized. With the exception of the aerosols end-uses, the later and slower transitions in the lower scenario have not yet accrued emissions reductions by 2020 to the extent of those accrued under the most likely scenario, which in turn has not yet reached the levels seen in the higher scenario.

Figure 2. U.S. Emissions Profile in Transition Scenarios and Baseline



The growth in emissions reductions can be seen in Figure 2. A short period of transition, during which the implementation of lower-GWP alternatives is increasing, is complete in all end uses by 2021 except those subject to narrowed use limits. This is followed by a period of large benefit increases until about 2030 under all three scenarios, due to the lifetime of the equipment and foams during which the emissions reductions from those end-uses are achieved. After about 2030, emissions reductions continue to grow roughly as a percentage of the growth of these sectors. In these years, the differences in emissions reductions realized under the various scenarios quickly stabilize. For example, in these later years the

[13] The latest date for changing the status of an alternative occurs in the foams polystyrene extruded boardstock and billet (XPS) end-use in 2021. Because the motor vehicle air conditioning provision affects MY2021 vehicles, much of the transition in that end-use will occur in 2020 or earlier. Narrowed use limits extend to 2022 in the foams sector and 2025 in the MVAC end-use.

reductions from the most likely scenario relative to the reductions from the lower scenario show approximately a 10 percent difference. Such differences are due to the differences in the mix of alternatives after transition in the different scenarios.

Conclusion

The EPA anticipates that 26 to 31 $MMTCO_2eq$ climate benefits associated with avoided emissions for the SNAP Status Change Rule in 2020 and 54 to 64 $MMTCO_2eq$ in 2025. Three scenarios the EPA considered were developed and compared with a business-as-usual scenario. If the EPA were to consider the emissions reductions in 2030 or another later date, the climate benefits would be greater.