

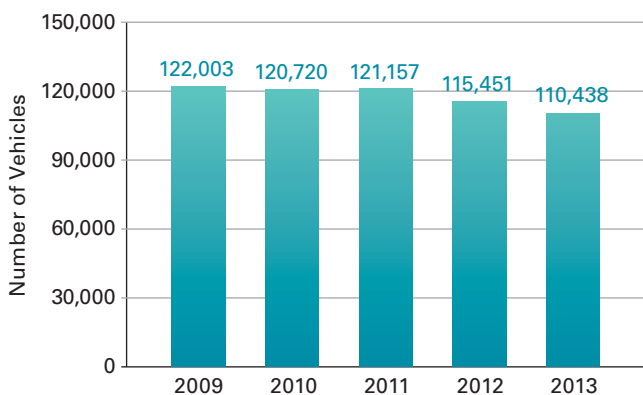
TRANSITIONING TO LOW-GWP ALTERNATIVES in Passenger Vehicle Air Conditioners

Background

This fact sheet provides current information on low global warming potential (GWP) alternatives in newly manufactured passenger vehicle air conditioners (ACs), in lieu of high-GWP hydrofluorocarbons (HFCs). HFCs are powerful greenhouse gases (GHG) thousands of times more potent per pound than carbon dioxide (CO₂), but more climate-friendly alternatives are becoming available.

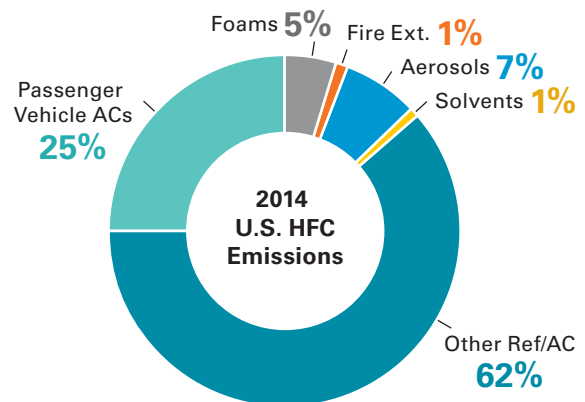
These AC systems cool passenger vehicles in the U.S. General Services Administration (GSA) fleet operated by diverse federal agencies. GSA passenger vehicles include sedans, station wagons, passenger vans, and SUVs. The figure below shows the passenger vehicle fleet size from 2009–2013. Passenger vehicles accounted for 60% of the total GSA fleet in 2013, with trucks accounting for 37% and other vehicles accounting for the remaining 3%; this fleet profile has been generally consistent since 2009.

Figure 1: GSA Passenger Vehicles^a by Year (2008–2012)



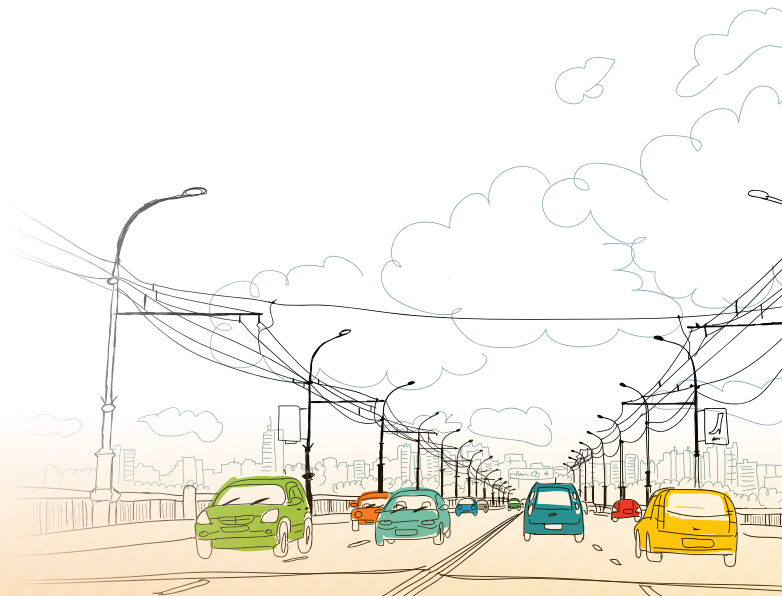
^a Includes sedans, station wagons, passenger vans, and SUVs

In 2014, U.S. HFC emissions from passenger vehicle ACs were estimated at 40.9 million metric tons of carbon dioxide equivalent (MMT CO₂eq),¹ or 25% of total annual HFC emissions in the United States. This is equivalent to the annual GHG emissions from approximately 8.6 million passenger vehicles.



U.S. HFC Emissions: 166 MMT CO₂Eq.
U.S. HFC Emissions in Passenger Vehicle ACs: 40.9 MMT CO₂Eq.

¹ Carbon dioxide equivalent is a measure of a substance's effect on global warming over a hundred-year timeframe, relative to the same amount of carbon dioxide.



Low-GWP Alternatives and Market Trends

In the past, passenger vehicles were cooled by chlorofluorocarbon (CFC)-12, a substance that destroys the stratospheric ozone layer that shields the Earth from the sun’s harmful ultraviolet radiation. Automobile manufacturers transitioned to the non-ozone depleting alternative HFC-134a in the mid-1990s. HFC-134a, like its predecessor, is a potent GHG that contributes to climate change. Today, many motor vehicle manufacturers are beginning to transition to new, climate-friendly alternatives.

EPA’s Significant New Alternatives Policy (SNAP) Program ensures the smooth transition to alternatives that pose lower overall risk to human health and the environment. Under SNAP, EPA recently listed three low-GWP passenger vehicle AC refrigerants as acceptable subject to use conditions: hydrofluoroolefin (HFO)-1234yf, carbon dioxide, and HFC-152a. None of these alternatives deplete the ozone layer and all have significantly lower impacts to the climate system than CFC-12 or HFC-134a.

A SNAP rulemaking published in July 2015 lists various refrigerants and refrigerant blends as unacceptable in newly manufactured, light-duty vehicles starting with model year (MY) 2017. The table below shows the time frame for when the changes in listing status will become effective for each refrigerant.

Substitute	GWP	Decision*
HFC-134a	1,430	Unacceptable as of MY 2021**
R-414B (HCFC Blend Omicron)	3,337	Unacceptable as of MY 2017
GHG-X5	2,377	
R-406A	1,900	
GHG-HP (HCFC Blend Lambda)	1,893	
Freeze 12	1,606	
Free Zone (HCFC Blend Delta)	1,592	
R-426A (RS-24, new formulation)	1,510	
R-414A (HCFC Blend Xi, GHG-X4)	1,478	
SP34E	1,410	
R-416A (FRIGC FR-12, HCFC Blend Beta)	1,080	

* Note: Refer to the Final Rule for more details on the changes in listing status.

**Narrowed use limits apply for export to countries without servicing infrastructure through model year (MY) 2025.

HFO-1234yf

- HFO-1234yf is a refrigerant being introduced by many automobile manufacturers; there are cars on the road today using this alternative, and at least nine MY2014 vehicles are using HFO-1234yf in the U.S., including those sold by General Motors, Chrysler, Honda, and Range Rover (see text box below)
- Cooling performance and fuel use comparable to HFC-134a

Carbon Dioxide (CO₂, R-744)

- CO₂ is a high pressure refrigerant being considered by automobile manufacturers; systems operate at 5 to 10 times higher pressure than other passenger vehicle AC systems
- Cooling performance, energy efficiency, and fuel use comparable to HFC-134a systems in temperate climates; efficiency may drop in hotter climates
- At least one global car manufacturer is beginning to develop CO₂ passenger vehicle AC systems
- Prototypes of compact electrically-driven systems for rail vehicles (e.g., trams and local trains) undergoing long-term testing in Europe

HFC-152a

- Prototype systems using HFC-152a are under evaluation globally
- Good energy efficiency and cooling performance but requires additional safety requirements compared to standard HFC-134a systems
- Although also an HFC, its GWP is only 9% that of HFC-134a

Refrigerant	GWP*
CFC-12	10,900
HFC-134a	1,430
HFC-152a	124
HFO-1234yf	4
CO ₂ (R-744)	1

Note: CFC-12 is no longer used in new equipment because of its ozone depletion potential.

* GWP values are from the Intergovernmental Panel on Climate Change Fourth Assessment Report: Climate Change 2007.

Future Outlook

Together, the suite of known alternative chemicals and new technologies can significantly reduce HFC emissions in both the near and long term. The auto sector is already transitioning to climate-friendly alternatives in passenger vehicles, proving that they can move quickly to protect the environment. As of the end of 2014, several million cars using HFO-1234yf were on the road in Europe and the United States. Within the next few years, it is expected that many if not most new passenger vehicle models sold on the U.S. market will contain climate-friendly alternative refrigerants.

SNAP Facts

- Authorized under Clean Air Act Title VI
- Evaluates substitutes and lists as acceptable those that reduce overall risk to human health and environment; lists acceptable with use conditions if needed to ensure safe use; or lists as unacceptable.
- Industrial sectors include: Refrigeration & Air Conditioning, Foam Blowing, Solvent Cleaning, Fire Suppression, Aerosols, Sterilants, Adhesives, Coatings & Inks, and Tobacco Expansion.
- Since it was established in 1994, SNAP has reviewed over 400 substitutes.
- SNAP considers:
 - Ozone Depleting Potential (ODP)
 - Global Warming Potential (GWP)
 - Flammability
 - Toxicity
 - Occupational & Consumer Health/Safety
 - Local Air Quality
 - Ecosystem Effects

The Emergence of HFO-1234yf Passenger Vehicle ACs in the U.S.

While HFC-134a has been the dominant refrigerant in use in passenger vehicle ACs since the early 1990s, the first passenger vehicle ACs with HFO-1234yf refrigerant emerged on the U.S. market in 2013—in the Cadillac XTS and the Honda Fit EV. At least seven other MY2014 vehicle models contain HFO-1234yf passenger vehicle ACs, including: Chevrolet Spark EV, Chrysler 300, Dodge Challenger, Dodge Charger, Jeep Cherokee, Range Rover, and Range Rover Sport.

References

- Arkema. 2013. Arkema is announcing construction of production capacities for new refrigerant fluorinated gas 1234yf. Press Release. September 4th, 2013. Available online at: <http://www.arkema.com/en/media/news/news-details/Arkema-is-announcing-the-construction-of-production-capacities-for-new-refrigerant-fluorinated-gas-1234yf/?back=true>.
- Coons, Rebecca. 2010. "Honeywell, DuPont Form JV to Produce Refrigerant." ChemicalWeek. May 24, 2010.
- DuPont. 2014. DuPont Statement: White House Event Highlights the Feasibility of Phasing Down HFCs under the Proven Montreal Protocol Framework. September 16, 2014. Available online at: http://www2.dupont.com/Refrigerants/en_US/news_events/article20140916.html.
- Greenpeace. 2010. "Cool Technologies: Working Without HFCs—2010, Examples of HFC-Free Cooling Technologies in Various Industrial Sectors." Presented at the 30th Open-Ended Working Group of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer. June 2010. Available online at: http://www.unep.ch/ozone/Meeting_Documents/oewg/30oewg/conf-ngos/COOLING%20%20WITHOUT%20HFCs%20-%202010-GREENPEACE.pdf. Accessed September 30, 2010.
- Honeywell. 2013. Honeywell Announces Major Investments To Increase HFO-1234yf Production In The United States. 10 December 2013. Available online at: <http://honeywell.com/News/Pages/Honeywell-Announces-Major-Investments-To-Increase-HFO-1234yf-Production-In-The-United-States.aspx>.
- International Panel on Climate Change (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. September 2007. Available online at: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html. Accessed September 30, 2010.
- Korzeniewski, Jeremy. 2009. "HFO-1234yf: Get Used to Hearing It." Autoblog Green. October 24, 2009. Available online at: <http://green.autoblog.com/2009/10/24/hfo-1234yf-get-used-to-hearing-it/>. Accessed September 20, 2010.
- Mendel, Jenny. 2010. "GM to Use Climate-Friendly Refrigerant." Greenwire. July 26, 2010.
- Nelson, Gabe. 2013. Automakers' switch to new refrigerant will accelerate with EPA credits, European mandate. Automotive News. Available online at: <http://www.autonews.com/article/20131230/OEM01/312309996/warming-to-the-idea#>.
- Technology and Economic Assessment Panel (TEAP). 2013. "Decision XXIV/7 Task Force Report: Additional Information to Alternatives on ODS." September 2013. Available online at: http://ozone.unep.org/AssessmentPanels/TEAP/Reports/TEAP_Reports/TEAP_TaskForce%20XXIV-7-September2013.pdf. Accessed August 21, 2014.
- Technology and Economic Assessment Panel (TEAP). 2014. "Decision XXV/5 Task Force Report: Additional Information to Alternatives on ODS (Draft Report)." May 2014. Available online at: <http://ozone.unep.org/en/teap-may2014-decision-xxv5-task-force-report-additional-information-alternatives-ods-draft-report>. Accessed August 21, 2014.
- U.S. Environmental Protection Agency (EPA). 2013. Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2011. April 12, 2013. Available online at: <http://www3.epa.gov/climatechange/ghgemissions/usinventoryreport.html>.

