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Bringing the U.S. Fridge Market into the 21st Century

Low-GWP Technology in Domestic Refrigeration

Executive Summary

HFC-134a, a type of hydrofluorocarbon (HFC) refrigerant with a high global warming potential (GWP) 1,430 times that of carbon dioxide, is used in virtually all new U.S. domestic refrigerators and freezers. Under proposed U.S. policy directives both at federal and state levels, HFC-134a will be phased out of the U.S. market for new domestic refrigerators and freezers by January 1, 2021.

Hydrocarbon refrigerants are widely proven and globally adopted low-GWP alternatives for this sector and have been taken up by other markets globally, with more than 1.5 billion hydrocarbon refrigerators and freezers used in homes around the world.[1] However, the U.S. domestic refrigeration sector is yet to adopt appropriate charge sizes to allow the broad adoption of hydrocarbon domestic refrigerators in the United States. Updates to U.S. and regional North American industry standards to harmonize charge sizes with international standards are needed in order to allow for this transition to hydrocarbons to take place for the U.S. market.

It is a common myth that larger-sized refrigerators sold in the United States, or "American style" refrigerators, are bigger than ones sold in other countries and therefore more difficult to design for with hydrocarbon refrigerants. American style refrigerators are gaining market share globally and can be made using the same 150-gram charge size allowed in all countries except the U.S. Our findings show that multinational companies selling refrigerators on the U.S. market are already producing and selling models using hydrocarbons for other global markets. Many of the models using hydrocarbons as the refrigerant are of a similar size and design to those sold in the United States.

Given the extent to which companies retailing on the U.S. market are already using these alternatives elsewhere, the transition to low-GWP hydrocarbons is not only technically feasible by 2021, but would also streamline product requirements for global manufacturers of these essential consumer goods. We outline the key drivers for the U.S. domestic refrigeration sector to transition away from HFC-134a to low-GWP hydrocarbon substitutes and present our findings on the market's readiness to make this transition.

Policy Directives Signal 2021 Phase-out of HFC-134a in U.S. Domestic Refrigeration

As the global refrigeration industry rapidly moves towards improved energy efficiency and alternative refrigerant innovation[2], the U.S. Environmental Protection Agency (EPA) has proposed policy changes to help curb high-GWP refrigerants. New directives proposed under the Significant New Alternatives Policy (SNAP) Program are adaptive to increasing information about the effects of high-GWP substances and industry changes that enable a transition away from HFCs to low-GWP, more energy efficient refrigerants. The EPA's new

Why should domestic refrigerators be HFC-free?

With approximately 10 million refrigerators sold annually in the United States, virgin HFCs consumed in domestic refrigerators on an annual basis account for nearly 2.9 million tonnes of CO_2eq. This is equivalent to the emissions of 755,160 passenger vehicles on the road for a year.

Table 1: Global Market Analysis of Hydrocarbon Refrigerators (AHAM Members)

Manufacturing Company	Region/Market	Refrigerant	GWP	Capacity Range (cu.ft.)
AB Electrolux of Sweden	Pacific / SE Asia	R-600a	3	21 - 25
	EU	R-290	3	24
	US	R-134a	1,430	22 - 26
Samsung Electronics America, Inc.	EU / Int.	R-600a	3	18 - 22
	US	R-134a	1,430	22 - 29
LG Electronics	UK	R-600a	3	20 - 24
	India	R-600a	3	21 - 30
	US	R-22	1,700	22 - 30
Sharp Electronics Corporation	Pacific	R-600a	3	20 - 22
	EU	R-600a	3	20 -22
Haier	Pacific	R-600a	3	20 - 22
	EU	R-600a	3	20 - 22
	US	R-134a	1,430	15 - 24

Source: EPA, ECCC, Company websites (Electrolux, Haier Group, etc)

proposed SNAP rule (Proposed Rule 21) would prohibit the sale of new domestic refrigerators and freezers using HFC-134a beginning in 2021.[3]

Proposed Rule 21 not only delists or limits the use of harmful substances such as HFC-134a, but also broadens the acceptable uses of low-GWP hydrocarbon refrigerants to additional sectors and equipment types.[4] These changes demonstrate that both public and private sector understand there are available substitutes or potentially available substitutes that pose less overall risk to human health and the environment. [5]

Stakeholders representing both industry and standards bodies voice differing perspectives on the feasibility of meeting the 2021 phase-out date for HFC-134a;[6,7] however, several major U.S. manufacturers are already utilizing these technologies internationally and are able to meet the 2021 transition

Figure 1: Electrolux ESE7007SG (R-600a) - 24.7 cubic feet

date to hydrocarbon refrigerants, provided the Underwriters Laboratory (UL) 250 standard is harmonized with the International Electrotechnical Commission (IEC) standard within the next two years.[8]

Similarly, California's Air Resources Board (ARB) proposed a strategy on short-lived climate pollutants (SLCPs), including HFCs,[9] that would have similar implications for the domestic refrigeration sector. It plans on banning refrigerants with a GWP greater than 150 in new equipment for all stationary refrigeration applications beginning in 2021. This is consistent with the EPA's proposed SNAP rulemaking and would additionally ban other refrigerants with GWPs above 150. As a major economy, the state's proposed strategy will play a significant role in driving demand for low-GWP alternatives.

The European Union has already implemented a comprehensive regulation on HFCs, including HFC-134a which was prohibited for use in new domestic refrigeration appliances beginning in 2015.[10] The EU regulatory requirements solidified Europe's transition to hydrocarbon refrigerators, a transition in which the United States lags years behind.

Climate Benefits of a 2021 Transition

Although HFC emissions in the domestic refrigeration sector are less compared to other sectors that use HFCs, this is an important and highly feasible sector to transition by 2021. Particularly considering the existing adoption of low-GWP refrigerants by other countries around the world, a U.S. transition in this sector will make a tangible and substantive contribution to the perceived ambition of U.S. policies to transition away from HFCs. A later transition date for this sector on the other hand, would contribute to significant and unnecessary ongoing climate impacts, while also detracting from the ambition of the U.S. transition away from HFCs.

With approximately 10 million refrigerators sold annually in the United States, virgin HFCs consumed in domestic refrigerators on an annual basis account for nearly 2.9 million tonnes of CO2eq. Comparatively, this is equivalent to the emissions of 755,160 passenger vehicles on the road for a year.[11] A three year delay extending the deadline for banning HFC-134a in domestic refrigerators until 2024 as proposed by certain industry stakeholders, would contribute approximately an additional 8.6 million tonnes of CO2eq emissions. The current policy proposals for 2021 transitions in the domestic refrigerator sector represent an achievable avoidance of significant HFC consumption and emissions.

Industry Standards: Market Readiness to Advance Harmonization for Low-GWP Alternatives

While most household fridges in the United States use HFC-134a (GWP=1430), as well as older refrigerants with even higher GWPs, more than 650 million refrigerators using hydrocarbons (GWP<4) were sold internationally by 2012,[12] which is estimated to have grown to more than 1.5 billion.[13] With clear U.S. policy directives proposed, the only remaining hurdle to a transition to hydrocarbons in the United States lies in restrictive charge sizes for hydrocarbon refrigerants under U.S. and North American standards compared to those in Europe, Asia, and other regions.

UL serves as the primary U.S. standard-setting organization and has described its role to "anticipate and ultimately address the safety challenges."[14]The IEC, the most widely recognized international standards body for refrigeration technologies, has more frequently and recently updated its standards to include safe and reasonable charge size limits for hydrocarbons, while the UL standard for household refrigeration (UL250) has yet to fully harmonize with IEC best practices.

While IEC 60335-2-24, the most widely followed standard globally, places a 150 gram charge size limit on A3 refrigerants including hydrocarbons, UL has not adopted this measure, maintaining the U.S. charge size limit at a 57 grams.[15] A recent proposal to harmonize the UL 250 standard with the IEC standard suggested all aspects of the IEC standard be adopted except charge size limits. The proposal was subsequently voted down by stakeholders, the majority of which desired that the issue of hydrocarbon charge sizes be addressed and harmonized.[16]

Some industry stakeholders have emphasized that the transition "necessitates significant research and development spending to develop technologies and products that can use alternative refrigerants in traditional U.S. refrigerators."[17] In order to objectively assess market readiness and the extent to which significant research and development or design challenges to harmonization exist, EIA conducted desk research on companies that are members of the Association of Home Appliance Manufacturers (AHAM), which represents U.S. appliance manufacturers (see Figure 1). Table 1 summarizes our findings that AHAM member companies or their parent companies supply a significant number of hydrocarbon refrigerators globally. Furthermore, these companies are manufacturing large two-door refrigerator models that resemble the design of larger 20-30 cubic foot refrigerators made for the U.S. market.

In public comments submitted to EPA on the Proposed Rule 21, Electrolux North America Inc., subsidiary of AB Electrolux of Sweden and AHAM member company, described the 57 gram charge as the "most critical issue to be resolved," and that there is "no reason to delay the implementation of a safety standard change that harmonizes the charge size limit for [hydrocarbon]-based refrigerants in the United States with that of the rest of the world."[18] Similarly, Whirlpool, the largest appliance manufacturer globally, argues that a

Figure 2: LG Electronics GR-J297WSBN (R-600a) - 29.7 cubic feet

multi-stakeholder group must evaluate the flammable refrigerant limit to determine whether the current charge size limit is appropriate.[19] These stakeholder comments suggest that a transition to hydrocarbons can be achieved with a three year lead-in time following the harmonization of standards on charge size.[20]

CANENA, the Council for Harmonization of Electrotechnical Standards of the Nations in the Americas, serves as the multilateral standards body for North America that is charged with harmonizing regional standards in the United States, Canada, and Mexico to effectively address globalization of manufacturing. While UL has urged the EPA to allow the voluntary standards setting process to proceed at its own pace,[21] it remains unclear given the state of the global marketplace why this process has not proceeded more quickly. There does not seem to be any remaining technical or safety reason for CANENA Technical Harmonization Committee 61C not to act swiftly to allow the harmonization of A3 charge sizes under North American regional standards with those allowed under IEC.

Conclusions

The United States' domestic refrigeration sector is well positioned to meet a January 1, 2021 deadline to transition away from high-GWP HFC-134a, provided that representatives participating in the CANENA and UL standards-setting bodies address charge sizes in a timely manner. EIA supports the policy proposals from the EPA and ARB that align on this deadline, and urges industry stakeholders to proactively engage in advancing harmonization of charge sizes for hydrocarbon refrigerants under United States (UL) and North American regional (CANENA) standards bodies with those in the international (IEC) standard.

EIA calls on fellow members of the standards technical panel for UL250, members of the CANENA Technical Harmonization Committee 61C, AHAM, and/or AHAM member companies, to submit a new proposal harmonizing UL250 with IEC 60335-2-24 that includes harmonization of charge sizes no later than December 31, 2016. This timeframe would allow finalization of a new standard by the end of 2017 and give manufacturers the requested three year lead in time to meet a January 1, 2021 transition.

Citations

[1] True Manufacturing, About Us, Natural Refrigerant, https://www.truemfg.com/AboutUs/Natural-Refrigerant

[2] Environmental Investigation Agency, Putting the Freeze on HFCs – 2016 Update

[3] EPA, April 2016, EPA–HQ–OAR–2015–0663; FRL–9941–84–OAR

[4] EPA, May 2016, EPA–HQ–OAR–2003–0118; FRL–9946–88–OAR

[5] EPA, March 2016, Fact Sheet - Proposed Rule - Protection of Stratospheric Ozone: New Listings of Substitutes; Changes of Listing Status; Reinterpretation of Unacceptability for Closed Cell Foam Products under the Significant New Alternatives Policy Program; and Revision of Clean Air Act Section 608's Venting Prohibition for Propane, Page 1, available at https://www.epa.gov/sites/production/files/2015-08/documents/snap_regulatory_factsheet_july20_2015.pdf

[6] Underwriters Laboratories Inc. (UL) comments on EPA-HQ-OAR-2015-0663

[7] Association of Home Appliance Manufacturers (AHAM) comments on EPA-HQ-OAR-2015-0663Comments of Electrolux North America, Inc. (ENA) on Proposed SNAP Rule 21, available at: https://www.regulations.gov/document?D=EPA-HQ-OAR-2015-0663-0104

[9] California Environmental Protection Agency – Air Resources Board, Proposed Short-Lived Climate Pollutant Reduction Strategy, April 2016, available at http://www.arb.ca.gov/cc/shortlived/meetings/04112016/proposedstrategy.pdf

[10] Official Journal of the European Union, April 2014, Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006

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[12] Greenpeace International, Cool Technologies: Working Without HFCs (2012), available at: http://www.greenpeace.org/international/en/publications/Campaign-reports/Climate-Reports/Cool-Technologies-Working-Without-HFCs/

[13] True Manufacturing, About Us, Natural Refrigerant, https://www.truemfg.com/AboutUs/Natural-Refrigerant .

[14] Supra viii.

[15] UL 250, Edition 10.

[16] UL 60335-2-24, Edition 2 (Proposed).

[17] Supra vii.

[18] Comments of Electrolux North America, Inc. (ENA) on Proposed SNAP Rule 21, available at: https://www.regulations.gov/document?D=EPA-HQ-OAR-2015-0663-0104

[19] Whirlpool Corporation comments to EPA-HQ-OAR-2015-0663, available at https://www.regulations.gov/document?D=EPA-HQ-OAR-2015-0663-0110

[20] Ibid.

[21] Supra viii.

Key Players in Standards for Domestic Refrigeration

UL250: The U.S. standard that allows only up to 57 grams of flammable refrigerant and is restricting commercialization of proven hydrocarbon technologies in the U.S. market.

CANENA Technical Harmonization Committee 61C: The North American regional standards body responsible for guiding cooperation on a harmonized standard across the United States, Canada, and Mexico.

IEC 60335-2-24: The most widely followed international standard on domestic refrigeration developed by the International Electrotechnical Commission (IEC). This standard allows up to 150 grams of flammable refrigerants and has allowed widespread uptake of low-GWP hydrocarbon fridges sold around the world.

Association of Home Appliance Manufacturers (AHAM): Important stakeholder group consisting of appliance manufacturing companies and member of technical panels under UL250 and CANENA THC 61C.

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