Refrigerant Phasedown Alternatives, and Factors Driving the Future of the Refrigerant Market

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An overview of key factors impacting the refrigerant market, including EPA's Significant New Alternatives Policy (SNAP) Program.

At approximately the same time the Montreal Protocol was ratified by the United States in 1989,[1] the U.S. Clean Air Act (CAA) Amendments of 1990 were taking final shape. This was fortuitous timing for protection of the ozone layer, as it afforded Congress the opportunity to incorporate requirements for the phaseout of ozone depleting substances (ODS), as required by the Montreal Protocol, into the final CAA Amendments.[2] For example, the CAA has banned production of certain ODS, such as chlorofluorocarbons (CFCs), since the 1990s.[3] The phaseout timelines illustrated in Table 1 show that the U.S. Environmental Protection Agency (EPA) has used supply controls to limit and phaseout ODS refrigerants since soon after the regulations were finalized. In fact, the origin of these supply controls can be traced back to the Montreal Protocol itself. This method of control is a crucial factor that affects the hydrochlorofluorocarbon (HCFC) refrigerant shortages and price increases the regulated community faces today.

A requirement of the 1990 CAA Amendments that is equally critical to these HCFC concerns is the development of a program to identify safe alternatives to ODS under Section 612 of the CAA. Section 612 authorized EPA to evaluate and regulate substitutes for those ODS refrigerants that were being phased out under the Montreal Protocol.[4] This CAA requirement was embodied in the Significant New Alternatives Policy (SNAP) Program within EPA's Protection of Stratospheric Ozone regulations in 40 CFR 82, Subpart G.[5]

Under the SNAP Program, EPA reviews several characteristics of proposed substitutes—including but not limited to ozone depletion potential (ODP), global warning potential (GWP), toxicity, and flammability—using a comparative risk framework for specific industrial sectors (e.g., refrigeration and air conditioning, foam blowing agents) and end uses (e.g., residential air conditioning, phenolic insulation board). SNAP Program decisions on substitutes are categorized as 1) acceptable, 2) acceptable subject to use restrictions, 3) acceptable subject to narrowed use limits, or 4) unacceptable.

SNAP's Shift in Focus

The requirements of the SNAP Program have not changed since the mid-1990s when they were promulgated. However, the decision-making process and determination of acceptable and unacceptable alternatives to ODS have evolved considerably in those 20 years. Not surprisingly, early SNAP designations focused on replacing those ODS having the highest ODP, typically CFCs such as R-11 and R-12, and subsequently HCFCs such as R-22 and R-123. As refrigerant technology continued to evolve, and the phaseout of true ODS refrigerants identified in the Montreal Protocol has been implemented, EPA shifted its focus to expanding the approval of non-ODS substitutes, including some of the most common refrigerants in use today—hydrofluorocarbons (HFCs) such as R-134a and R-410A.[6]

The most recent and substantial shift in the focus of the SNAP Program was heralded by the unveiling of President Obama's Climate Action Plan, which contains commitments for reduction of HFCs.[7] That plan appeared to set in motion the proposed regulation of substitutes primarily due to their GWP rather than their ODP. The first of these regulations was proposed the following year,[8] and have since been finalized.[9] An example of a 20-year progression from CFC to HCFC to HFC for one specific end-use is illustrated in Table 2.

The combined impact of phaseout and SNAP decisions on the continually escalating price of refrigerant is illustrated in Table 1. This trend may continue as a SNAP determination published in the *Federal Register* in July 2017[10] illustrates that the impact of GWP on SNAP decisions still plays a role in SNAP decision- making, regardless of the recent change in administration.

Table 1: ODS phaseout timetable.

		1996	2006	2010	2016	2017	2019	2020	2024	2029	2034	2034
R-12	Phaseout	100%										
	Price[a]		$866		$1,200	←			???			→
R-22	Phaseout			75%[b]				100%				
	Price[a]		$72		$730	$747	←		???			→
HFCs	Phaseout[c]						10%		40%	70%	80%	90%
	Price (R-410A)[a]	$240		$198	←				???			→

Notes: a Typical price for 30-lb tank of refrigerant.
b 75% reduction in HCFCs based on no production or import of R-142b and R-22, except for use in equipment manufactured before 1/1/2010.
c As included under Kigali Amendment to Montreal Protocol, not yet ratified by United States.

Supply Control: A Long-Established Method with Drawbacks

To meet the requirements of the Montreal Protocol, EPA chose an allowance system to phaseout HCFC production and consumption, and since 2003, it has issued annual allowances through a series of allocation rulings. In other words, the agency indeed chose to control supply rather than demand of HCFCs. However, this method has not come without complications that many end users are experiencing today or will experience soon when needing to service equipment using popular HCFC refrigerants. As a case in point, consider how this allowance system has impacted the most commonly used HCFC, R-22.

R-22

In its most recent allocation rule, which was published in October 2014, EPA announced a five-year linear approach for the phaseout of R-22 production for 2015–2019.[11] The rule allocated 13 million pounds of R-22 for 2017. That number drops to 9 million in 2018 and 4 million in 2019. To put that into perspective, 13 million pounds is approximately 5 percent of the projected R-22 service needs of the United States, which means that there is only a 1 in 20 chance the R-22 refrigerant needed to service an existing R-22 unit is newly produced in 2017 and available on the market. The remainder of the refrigerant needed will have to come from existing stockpiles and reclaimed refrigerant. And, the supply gap will only become more pronounced as the production allocations continue to drop until 2019, when less than 1 percent of the refrigerant available for service needs will be newly produced.

On or after January 1, 2020, no new or imported R-22 will be allowed in the United States. Then, the only available R-22 will come from recycle and reclamation, which today accounts for less than 2 percent of needs; or existing R-22 stockpiles, which have experienced an overall decline in recent years. To complicate matters further, when the allocations of R-22 were delegated, there was an overestimate of the rate of R-22 recycle and reclaim, and as a result, a shortage looms. But the market confusion does not stop there. As an illustration, consider the fact that, as recently as 2014, R-22 equipment was readily available for sale in the United States, constituting a sizeable percentage of total equipment sales.[12] This equipment was sold as "dry-charged" (i.e., not filled with refrigerant), even after a ban on producing R-22 charged equipment went into effect as of 2010.[13]

The point is, while rarely admitted, such supply controls have taken for granted that end-users of controlled refrigerants have the needed awareness on this long-planned (nearly two decades prior) and calculated phaseout, let alone that those end-users are prepared and have a plan for transition to alternative refrigerants. Thus, far too many end-users will continue to allow their appliances leak vital, soon-to-be obsolete refrigerant due to limited availability, and then be caught off guard when the supply of these substances dwindle rapidly. Accordingly, the long-established method of supply control has its drawbacks: leakage of refrigerant continues, and low recycle and recovery rates remain. And, even when refrigerant leaks do not surpass EPA mandatory leak repair thresholds included in 40 CFR 82, Subpart F, consumption still exceeds access to outdated refrigerant that is still in service.

Shifting from Supply-Side to Multi-Sided Control

Recently, there has been a shift in the method of control for the phaseout of HCFCs, and it is not nearly as one-sided as it has been in the past. That is, if you look to EPA's SNAP Program, specifically Rule 20 and Rule 21, you will see evidence of demand controls now being used to phasedown certain refrigerants and phase in others. This multi-sided approach to control may very well help end-users better prepare for the fast changing world of refrigerants. Of course, bear in mind that the SNAP Program simultaneously adds further complexity to the transition.

For example, returning to the case example of R-22 phaseout, many affected stakeholders with R-22 equipment will be faced with the option to either retrofit the equipment to use an alternative refrigerant or replace the equipment entirely.

Table 2: Example 20-year progression from CFC to HCFC to HFC.

Rule Date:	1994	1996	2002	2016	2017+
Commercial Comfort Cooling with Centrifugal Chillers	R-22 is an acceptable substitute for R-12 (N)	R-410A (N) or R-407C (N/R) are acceptable substitutes for R-22	R-410A (N) or R-407C (N/R) for R-22	R-407C and R-410A are Unacceptable (N) as of 1/1/2024	???

Notes: (N) Indicates use in a new equipment
(R) Indicates use in retrofitting existing equipment to use the listed refrigerant

Those who choose replacement, which is the costlier of the two options, must proceed with caution and take into account relevant SNAP rulings. Consider the popular replacement option for R-22 units, the HFC blend R-404A. R-404A may seem like a good choice for the long-term (in certain applications), but such a choice may be misplaced due to recent SNAP decisions, which have begun R-404A's phasedown ahead of the Kigali Amendment to the Montreal Protocol by listing it as unacceptable in several air-conditioning and refrigeration end-uses.[14,15] [*Editor's Note:* The Kigali Amendment to the Montreal Protocol is described in detail in the article by Janet McCabe elsewhere in this issue of *EM*.]

Thus, replacement options will come with complications and associated costs. One such additional complication is the vacatur of SNAP Rule 20 by the U.S. Court of Appeals for the District of Columbia that occurred on August 8, 2017.[16] The 2-to-1 decision indicates that EPA cannot utilize the SNAP Program to disapprove of previously approved non-ODS substitutes such as HFCs. While EPA had not commented on the decision at the time this article was written, EPA and/or one or more of its intervenors are expected to appeal this decision to the D.C. Circuit.

Along similar lines, material origins add another layer of complexity that system owners must consider. Tariffs have been applied to many common refrigerant gases (e.g., R-410A and R-134a), which means they spend a longer time in port to be evaluated and as a result their total costs increase.[17]

These market events have an impact on the supply availability options of the approximately 5,000 U.S. distribution locations.

So, what this multi-sided control effort really means is that heating, ventilation, and air conditioning/refrigeration (HVAC/R) management decisions may come with additional complications. In fact, expect faster phaseout of refrigerants, fewer options for replacements, and more rapid financial obsolescence of equipment. Also, with the rapid changes in the regulatory landscape, the useful life of an appliance may be much shorter than its typical depreciation period, so acceleration of appliance depreciation must be considered.

A Farewell to Cold and Cheap Comfort (For the Better)

While the transition away from HCFCs and HFCs is not straightforward, it is clear that the old days of cold and cheap comfort are gone… and it is for the better. In fact, there is a strong and unified consensus unique to the HVAC/R industry that the best path forward is to replace the old refrigerant gases with better, more environmentally sound materials that cause fewer problems, like hydrocarbons (HCs) and hydrofluoroolefins (HFOs). In fact, before the Trump Administration had taken office, the HVACR Industry Alliance solicited their support for this shift in a letter to then-Vice President-Elect Mike Pence: "The HVACR Alliance strongly supports Senate ratification of the Kigali Amendment to the Montreal Protocol and urges members of the Senate to align U.S. policy with the direction U.S. manufacturers are heading with regard to [phasing down the use of] HFCs."[18]

Specifically, HC materials, which have flammable properties, will become more prevalent, resulting in a need for new regulations to safeguard the workforce. Danielle Wright, Executive Director of the North American Sustainable Refrigeration Council, embraces this next generation of gases, stating: "The global phasedown of HFCs is driving retailers to invest in 'future-proof' refrigerant solutions. It is also motivating equipment manufacturers to develop innovative new technologies that are making natural[ly occurring] refrigerants not only a viable option but the optimal choice in terms of performance and return on investment."[19]

Undoubtedly, the best advice is to stay alert. Many popular refrigerants are already being phased out; some have just begun being phased down; and others have been impacted by increased costs. In the coming years, multi-sided control efforts will radically transform the industry. Amendments to the Montreal Protocol will be signed, the SNAP Program will continue to evolve, more controls will be deployed, and the impact to end-users will be primarily financial. Meanwhile, the HVAC/R industry is attempting to act responsibly to deploy alternative solutions in a timely and cost-effective manner. **em**

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