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2021 Refrigerant Rulemaking in Review

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The regulation of refrigerants continues to be a source of great uncertainty in the commercial refrigeration industry. At the heart of this issue is the potential for carbon emissions from hydrofluorocarbon (HFC) refrigerants and their collective contribution to climate change. As global, national and state regulations have targeted the phase-down of HFCs in recent years, the industry has experienced a shift toward alternative refrigerants with lower global warming potential (GWP). While more environmentally friendly, it is important for owners and operators to inform themselves how to properly use these newer refrigerants to address potential performance and safety concerns, with many of the lowest-GWP alternatives bearing a degree of flammability.

Background and context

The current regulatory uncertainty is the result of years of flux — which unfortunately isn't getting any less complicated. In 2017, the U.S. District Court of Appeals for the District of Columbia (D.C.) Circuit ruled to vacate the Environmental Protection Agency's (EPA) Significant New Alternative Policy (SNAP) Rule 20. The court ruled that the EPA did not have the authority to require those who had already moved away from using ozone-depleting substances (ODS) to phase down to lower-GWP HFCs under its Clean Air Act (CAA) — which was originally intended to eliminate the use of ODS. Thus, the EPA could no longer enforce the GWP-based guidelines of its 2015 landmark rule.

Despite widespread business and HVACR industry objections to overturn the D.C. Court of Appeal's decision, the Supreme Court declined to hear the HFC case in 2018[1]. In response to the D.C. Circuit's decision, the EPA published a "Notification of Guidance," stating that it would not implement any of the HFC restrictions set forth in SNAP Rules 20 and 21. The Natural Resources Defense Council (NRDC) filed a lawsuit, claiming that the 2018 Guidance was overly broad because it did not distinguish between ODS and HFC replacements, and that the EPA had not followed proper procedures, as it was published without seeking stakeholder comments.

On April 7, 2020, the United States Court of Appeals for the D.C. Circuit granted the NRDC's petition, stating that the EPA guidance was procedurally inappropriate. The court agreed that the initial 2017 decision did not require the EPA to eliminate the enforcement of SNAP Rules 20 and 21 in their entirety[2].

These legal proceedings have not only halted the EPA's progress on governing HFCs, but they have left the U.S. without a clear path forward in terms of a unified refrigerant strategy. Since its passing in 2015[3], SNAP Rule 20 had been the law of the land, and the industry had already made great strides toward meeting its mandates. While much of the industry still supports the move toward a more sustainable and environmentally friendly future, court rulings around SNAP Rules 20 and 21 have created many questions about what the path forward will look like.

Making sense of these events and their near- and long-term implications requires an understanding of regulatory developments on the federal, state and international levels.

EPA rescinds additional HFC-related regulations

In response to the 2017 court ruling, the EPA has also rolled back other HFC-related regulations. It has excluded HFCs from the leak repair and maintenance requirements for stationary refrigeration equipment, otherwise known as *Section 608 of the CAA*[4].

The updated rule, which had been in effect since 2016, lowered the leak rate threshold in supermarket refrigeration systems from 35 to 20 percent and set forth specific requirements pertaining to HFC management. With the rescinding of this rule, refrigeration equipment with 50 pounds or more of HFC refrigerant would no longer be subject to these requirements.

Even if the leak repair and maintenance requirements of Section 608 are no longer enforced for HFC systems, an effective leak repair and maintenance program is still generally recognized as an industry best practice. Other beneficial provisions of Section 608 — including the certified technician program and the refrigerant recovery and reclamation rules — are still in effect[5].

California fills the regulatory void

In absence of regulatory certainty at the federal level, many states are adopting environmental regulations that seek to limit the negative impacts of short-lived climate pollutants (SLCPs) such as HFCs. California was the first state to take official action. California Senate Bill 1383, also known as the *Super Pollutant Reduction Act*, was passed in 2016 and requires that Californians reduce F-gas emissions by 40 percent by 2030[6]. The California Air Resources Board (CARB) has been tasked with meeting these reductions.

Since 2016, CARB had been using EPA SNAP Rules 20 and 21 as the bases of its HFC phase-down initiatives. With the vacating of SNAP Rule 20 in 2017, CARB moved to adopt its compliance dates that were already implemented or upcoming. This first phase of CARB rulemaking took place in March 2018 and helped to maintain the progress that the state had already made in transitioning from HFC refrigerants.

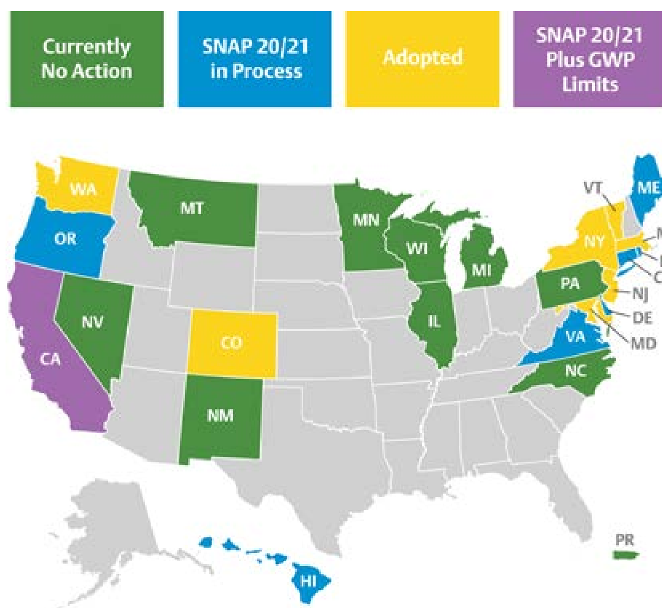
To strengthen these efforts, California Senate Bill 1013 was signed into law in Sept. 2018[7]. Referred to as the *California Cooling Act*, this law mandates the full adoption of SNAP Rules 20 and 21 as they read on Jan. 3, 2017. Currently in effect, this law authorizes CARB to uphold future compliance dates and includes the following provisions:

- The option to modify compliance dates
- The ability to list or delist refrigerants, regardless of federal status
- Prohibits selling, leasing or renting equipment inconsistent with provisions
- Establishes an incentive program to promote the adoption of new refrigerant technologies

To reach the 40 percent reductions required by 2030, CARB also proposed an aggressive second phase of rulemaking that will further impact commercial refrigeration and AC applications. On Dec. 10, 2020, the CARB board voted to approve the proposal, which includes the following requirements[8]:

- Refrigerants with a GWP greater than or equal to 150 will not be allowed in new stationary refrigeration systems charged with more than 50 pounds, effective in 2022.
- Existing food retail facilities with refrigeration systems charged with more than 50 pounds must collectively meet a 1,400 weighted average GWP or 55 percent greenhouse gas potential (GHGp) reduction relative to a 2019 baseline by 2030.
- Refrigerants with a GWP greater than or equal to 750 will not be allowed in new stationary air conditioning equipment, effective 2023.

U.S. Climate Alliance action on SNAP 20/21



Members of the U.S. Climate Alliance have vowed to reduce HFCs and SLCPs; some are either planning or have already adopted EPA SNAP 20/21. California is pursuing even further GWP limits.

Other states follow California's lead

With California taking a leadership role on environmental regulations, it is very likely that other states will adopt a similar (if not identical) approach. In 2017, a coalition of 16 states and Puerto Rico emerged to form the U.S. Climate Alliance, with a shared commitment of reducing SLCPs and HFCs. Since then, the Alliance has grown to 25 members — comprising more than 55 percent of the U.S. population and an $11.7 trillion economy; several of its states have announced plans to follow California's lead on HFC phase-downs.

Industry advocates, including the Air-conditioning, Heating, and Refrigeration Institute (AHRI) and the NRDC, have asked for states to be consistent in their approach to adopting CARB's rules.

Refrigerant safety standards and codes under review

Meeting the targeted emissions reductions in California will likely require the use of low-GWP refrigerants. But many of these low-GWP, hyrdrofluoroolefin (HFO) refrigerants are classified as A2L, or mildly flammable. The natural A3 refrigerant R-290 (propane) is also becoming more widely used in low-charge, self-contained commercial refrigeration applications. Currently, governing bodies and agencies are evaluating the standards that establish allowable charge limits and the safe use of these flammable A2L and A3 refrigerants.

Recently, the Underwriters Laboratories (UL) approved the second edition of its UL 60335-2-89 standard, which includes higher R-290 charge limits that would expand its potential uses in commercial refrigeration. The UL's updated 60335-2-89 standard raises the charge limits on commercial self-contained, plug-in displays based on whether they have an open or closed design.

- For open appliances without doors, the maximum charge limit has been raised to 500g, which is 13 times the lower flammability limit (LFL) of R-290.
- In closed appliances with doors or drawers, the new charge limit is 300g, or eight times that of R-290's LFL.

Further industry approvals are needed to enable these higher charge limits and expand the use of R-290 in U.S. commercial refrigeration applications. These include:

- EPA SNAP approval
- American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) 15 safety standard update for refrigeration systems
- Model code updates in the upcoming code revision cycle
- State and local building code updates

Once adopted, these safety standards will serve as the bases for codes that govern building, fire and other local authorities having jurisdiction (AHJ), who will ultimately oversee the applications in which these refrigerants are used. It is important to remember that building codes vary from state to state; thus, the adoption of flammable refrigerants ultimately will take place on local levels and may take years to accomplish.

Kigali Amendment not yet ratified in the U.S.

When considering the regulatory uncertainty in the U.S., it is easy to forget that the Montreal Protocol has been evaluating the global warming potential of HFCs for over a decade[10]. In 2016, 197 countries met in Kigali, Rwanda, and agreed on a global proposal to phase down HFCs. The Kigali Amendment required ratification from at least 20 countries to take effect. To date, 111 countries (including the E.U. Member States, but not the U.S.) have ratified it. As such, it took effect for participating countries on Jan. 1, 2019.

The Biden administration has issued an Executive Order recommending the ratification of the Kigali Amendment. Many industry stakeholders believe that doing so would be beneficial to our current state of regulatory and economic affairs. Ratification could help to establish a framework for future refrigerant regulations that would provide the certainty needed to help the industry and regulatory bodies move forward with a unified approach.

According to an economic study co-sponsored by AHRI and the Alliance for Responsible Atmospheric Policy, ratifying the amendment could create up to 33,000 jobs in the manufacturing sector by 2027 and is expected to have a positive impact on the U.S. economy[11]. For these reasons, many in the industry are in favor of ratification and have demonstrated this through letters of support to the Senate and the White House.

Federal HFC legislation

As part of major pandemic relief legislation, the American Innovation & Manufacturing Act (AIM Act) was passed by Congress and signed into law in late 2020. This legislation grants the federal government the authority to phase down the production and consumption of HFCs in a manner consistent with the Kigali Amendment to the Montreal Protocol. It also authorizes the EPA to restrict the use of specific HFCs in certain applications and otherwise manage the transition into HFC substitutes. This new authority is critical to eventual ratification of the Kigali Amendment. Without this legislation, the federal government lacks express authority to phase down HFCs. Such authority is a prerequisite to consideration of the Kigali Amendment by the Senate.

The AIM Act regulates HFCs in three ways:

- It gradually phases down the production and consumption of HFCs over a 15-year period via an allowance allocation program, similar to the way ozone-depleting substances were regulated under Title VI.
- It authorizes the EPA to establish standards for the management of HFCs used as refrigerants, such as in equipment servicing and repair, and for the recovery of "used" HFCs for purification and resale, also known as *reclaim*. This allows for a safe and efficient transition out of HFCs.
- It authorizes the EPA to establish sector-based use restrictions as a way to facilitate transitions to next-generation refrigerant technologies. These use restrictions would complement the broader HFC production and consumption phase-down, aiding sectors able to transition more quickly out of HFCs and providing additional flexibility for those sectors in need of more time to complete a transition.

This bill would not interfere with the use of HFCs in existing refrigeration and air conditioning equipment, i.e., consumers would not be forced to replace equipment before the end of its useful life. The bill also would not constrict aftermarket supplies of HFCs for servicing existing equipment.

With so many pending regulatory changes, staying abreast of available technology will be key to avoiding fines and costly rework for industry operators and end users.

Selecting a future-proof refrigeration system

In the U.S., centralized direct-expansion HFC racks have been the standard commercial refrigeration system for decades, and still make up the majority of current systems. But in California, and likely other regions within the U.S. Climate Alliance, this may soon change — especially considering CARB's proposed 150 GWP limit in systems charged with more than 50 pounds of refrigerant.

When considering lower-GWP refrigeration system alternatives, there is no one-size-fits-all solution, and the next generation of refrigeration technologies must address a much broader set of operational concerns, including: leak identification and mitigation; energy-efficiency goals; sustainability initiatives; maintenance, servicing and operational requirements; and system costs (both first and lifecycle costs). Operators must also attempt to align evolving store formats and layouts to these available architectures.

With all these factors in mind, let's look at some of the leading refrigeration architectures that utilize low-GWP refrigerants.

Micro-distributed, R-290 integrated cases

Flexible and efficient, these R-290-based, self-contained units feature the refrigeration system built (or integrated) into the refrigeration case. Multiple-unit configurations feature a water-cooled condensing unit in each case and utilize a shared water/glycol loop to remove excess heat from the store. These low-charge systems, which operate on 90 percent less refrigerant than a centralized system, are based on factory-built, hermetically sealed systems — which are considered less likely to have issues with potential refrigerant leaks. Because floor layouts are relatively easy to change, new stores (or retrofits) can be deployed and opened faster.

Of course, there are some challenges with using R-290 integrated cases. Namely, its small charge limits require the use of more compressors than would be needed for other approaches. But as future charge limits increase, operators have the potential to more than double the size of current R-290 systems — making micro-distributed architectures even more viable as an alternative to traditional and new low-GWP A1 systems.

Macro-distributed (large) integrated cases

As an alternative to R-290's low-charge limitations in micro-distributed systems, a macro-distributed approach offers the capability to support larger cases with a single compressor and refrigeration circuit — where potentially multiple R-290 circuits would be needed to supply the same refrigeration load. Utilizing the same shared water-loop, heat-rejection design as micro-distributed systems, these systems are designed to use available lower-GWP A1 refrigerants (such as R-448A at 1,300 GWP) and stay below the 50-pound CARB threshold. As very low-GWP A2L and A3 refrigerants become approved for use in higher charge limits, operators can utilize the same equipment and architecture — maximizing their investments to take a gradual approach to adopting sustainable refrigeration and regulatory compliance.

Micro-booster (distributed)

This innovative system architecture utilizes low-GWP, low-pressure A1 refrigerants (such as R-513A at 573 GWP) and features a booster compressor on each LT case that's designed to discharge refrigerant into the MT suction group. Thus, it eliminates high-discharge temperatures and the high compression ratio issue common with traditional low-temperature systems while offering greater reliability and much improved energy efficiencies. The system also provides future-proof readiness via compatibility with A2Ls below 150 GWP while relying on simple, reliable and familiar components.

Small-charge distributed

Another way store owners and operators are moving away from centralized systems is to distribute multiple "mini racks" in proximity to refrigerated aisles and cases. This strategy reduces the length of piping lines and keeps charges much lower than centralized systems, though they may still exceed 300 pounds. Because these mini racks utilize A1 refrigerants, systems would need to be kept below 50 pounds to meet CARB's proposed requirement. But the advantages include reliable operation, high energy efficiency, familiar components and simplified installation.

CO_2 transcritical booster

In large supermarkets where centralized architectures are preferred, CO_2 transcritical booster technology is a globally established, viable solution for providing both low- and medium-temperature cooling. This all-CO_2 system is called *transcritical* because it is designed to operate at temperatures and pressures above CO_2's critical point. While CO_2 transcritical booster systems deliver high energy-efficiency levels in moderate climates, they experience declining efficiencies in warmer regions. Technology enhancements, such as parallel compression, adiabatic gas coolers and ejectors, can be used to improve CO_2 system energy efficiencies in these regions.

In Europe, more than 20,000 CO_2 transcritical booster systems are already installed in food retail operations. And in North America, adoption has grown to nearly 900 systems (550 in U.S.; 320 in Canada). To ensure a successful CO_2 deployment, operators should have access to a trained, skilled workforce for service and maintenance and utilize a robust design to avoid shutdowns and charge losses.

CO_2 sub-critical (cascade)

CO_2 cascade systems utilize two distinct refrigeration circuits: one CO_2 circuit for the LT suction group, and an HFC (or HFO/HFC blend)-based circuit for the MT needs. Heat produced from the LT circuit is discharged (i.e., cascaded) into the suction stage of the MT circuit via an intermediate heat exchanger; MT compressors send gas to an air-cooled condenser on the roof. This design keeps CO_2 pressures low — below its critical point (or subcritical mode) — much like a standard refrigerant.

While eliminating the need for HFCs on the LT circuit significantly improves system sustainability, the MT refrigerant may yet be subject to future regulatory action.

Preparing for a quickly changing landscape

Over the next few years, the commercial refrigeration industry will have to keep a close watch over the potential changes in our dynamic regulatory climate. While the landscape may currently be in flux in the U.S., there's no question that the pace of transition away from HFCs is quickening. Many operators, such as those in California, are evaluating their refrigeration options and preparing for a future that utilizes lower-GWP refrigerants. Others simply want to align their refrigeration strategies with corporate sustainability objectives. Regardless of what's driving your future refrigeration strategy, Emerson is developing technologies to address a full spectrum of refrigeration considerations — from small to large retail formats, low-GWP to very low-GWP refrigerants, and distributed to centralized architectures. Since the early phases of this refrigerant transition, we have partnered with consultants, equipment manufacturers and end users alike to design, develop and implement future-ready, low-GWP refrigerant technologies. From our wide range of energy-efficient compressors, flow controls and smart electronics to fully integrated packaged systems, we're helping our customers to transition to sustainable refrigeration strategies that align with their unique facility requirements and business objectives.

Partner with Emerson to reach your sustainability goals

Emerson provides the HVACR consulting, system design and testing services you need to stay ahead of ever-changing regulations.

The guidance you need — the expertise you can trust

By taking an active role in organizations such as AHRI, ASHRAE and CANENA, Emerson remains informed on and close to the ever-changing landscape of international, national and state-level refrigeration regulations.

Why go it alone?

Think of us as an extension of your team. Our experts on industry-leading refrigeration technology and can enter the engagement at any stage to develop a solution custom-tailored to your needs, precisely calculated to meet your specifications and deemed most viable through feasibility studies.

Meet your budget, schedule and compliance requirements with Emerson.

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