

# Making equipment decisions in a changing landscape of refrigerant legislation

## A QUICK GUIDE



As the HVAC and building management industry navigates the complex and ever-changing refrigerant landscape, many questions are abound for building equipment owners and operators. Where will the evolving codes and regulations lead? What refrigerants will be adopted as the new global standards? And how can well-informed decisions be made when buying or maintaining HVAC equipment?

Today, future refrigerant options are being reviewed and finalized. Some alternative refrigerants are just now entering the market. With an upcoming refrigerant transition, now is the time to learn about what is changing and why. Those who educate themselves now will be in a better position to make the best equipment choices in the future based on safety, efficiency, cost, and availability.

## Refrigerants, global warming potential and energy efficiency

Refrigerants first became an environmental issue because refrigerants that contain chlorine – like Chlorofluorocarbons or CFCs (i.e., R-11, R-12) and Hydrochlorofluorocarbon or HCFCs (i.e., R-22, R-123) – damage the Earth’s ozone layer. Hydrofluorocarbon (HFC) refrigerants (i.e., R-410A, R-404A, R-134a), which contain no chlorine and have zero ozone depletion potential, were not affected by the CFC and HCFC phase-outs. However, concerns about climate change have led to worldwide efforts to reduce greenhouse gas emissions, specifically considering the global warming potential (GWP) of HFC refrigerants. One of these is the HFC Amendment to the Montreal Protocol which agreed upon a goal to achieve an 80-85 percent global reduction of CO<sub>2</sub> equivalents by 2047.

Today, the environmental spotlight is naturally shifting to the GWP of refrigerants. Greenhouse gases trap the sun’s heat, bringing unwanted changes to the Earth’s environment. When scientists speak of the global warming impact of refrigerants, they generally differentiate between the direct effect and the indirect effect. For refrigerants, the direct effect is indicated by the GWP rating, which measures how much a given mass of greenhouse gas contributes to global warming.

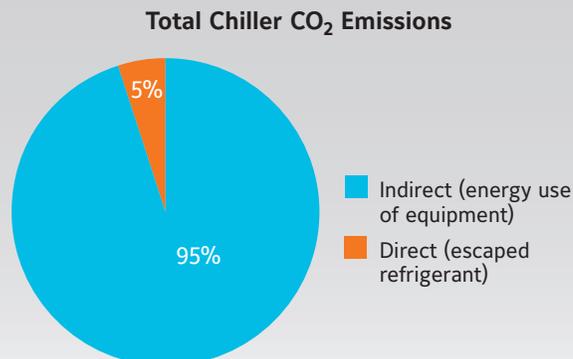
It is important to realize that the direct effect occurs only when refrigerant is released into the atmosphere. Advanced manufacturing, technology, and design – along with improved service practices, education, and training – have significantly reduced the potential for refrigerant to be released into the atmosphere. The direct effect of refrigerants in equipment is exceptionally small, often 5 percent or less of the refrigerant’s total global warming impact.

### KEY REFRIGERANT TERMS

**CFCs:** Chlorofluorocarbons are compounds that contain chlorine and damage the Earth’s ozone layer when released into the atmosphere. CFCs were widely used as refrigerants until they were phased out under the original Montreal Protocol. CFCs commonly used in air conditioning included R-11 and R-12.

**GWP:** Global warming potential is a measure of the degree to which greenhouse gases, including refrigerants, trap heat in the atmosphere.

**HCFCs:** Hydrochlorofluorocarbon refrigerants also contain chlorine, though far less than CFCs, and are in the process of



The indirect effect is caused by carbon dioxide (CO<sub>2</sub>) emissions from the power plants that produce the energy that the chiller uses. These emissions are caused by burning coal or other fossil fuels to make electricity. Environmentally conscientious building owners and operators can achieve better environmental outcomes by focusing on the energy efficiency of their chillers. Total chiller energy consumption accounts for over 95 percent of a chiller’s greenhouse gas emissions.

### TO REDUCE GREENHOUSE GAS EMISSIONS

- Maximizing equipment efficiency under all operating conditions
- Maintaining equipment for peak performance
- Repairing leaks quickly to minimize emissions
- Using equipment that uses low-GWP refrigerants when safe, optimized, and cost-effective

being eliminated under the original Montreal Protocol. HCFCs commonly used in air conditioning include R-22 and R-123.

**HFCs:** Hydrofluorocarbon refrigerants do not contain chlorine, but they do have higher GWP. These refrigerants are today’s technology of choice for chillers and include R-410A and R-134a for commercial applications.

**SNAP:** The Significant New Alternatives Policy of the U.S. Environmental Protection Agency evaluates refrigerants and classifies them as acceptable or unacceptable for different applications. A refrigerant classified as unacceptable cannot be used for new equipment within the specified application.

## Key legislation and affected refrigerants

Towards the end of 2016, two agreements were made regarding refrigerant transition. The Montreal Protocol Amendment Agreement and the U.S. Environmental Protection Agency (EPA) Significant New Alternative Policy (SNAP) Ruling.

The Montreal Protocol Amendment Agreement was signed by 197 countries on October 15, 2016 in Kigali, Rwanda. The objective of the amendment is for individual countries to take actions to address greenhouse gas emissions through the phase-down targets of HFC refrigerants in all industry sectors. The overall target goal is to achieve an 80-85 percent global reduction in CO<sub>2</sub> equivalents by 2047. The agreement does not identify a phase out of HFC refrigerants, like the original Montreal Protocol agreement for ozone depleting refrigerants.

HCFC refrigerants such as R-11, R-12, R-22, and R-123, have a set refrigerant production elimination timeline. The amendment agreement is not a phase out, but rather a phase-down approach for HFC refrigerants such as R-134a and R-410. 2019 is the first step-down date for Developed Nations and the goal is a 10 percent reduction of the baseline. This step-down will be met (or exceeded) based on the already identified and finalized regulations like the U.S. EPA SNAP Final Ruling and European F-gas Regulation. These regulations first phase-down HFC refrigerants for the industries that make up a very large market for these refrigerants and have high leakage rates, such as foam, automotive and commercial refrigeration.

The U.S. EPA Significant New Alternatives Policy (SNAP) ruling announced September 26, 2016, will impact new chillers starting January 1, 2024. Through SNAP, the U.S. EPA lists and de-lists the use of specific refrigerants in new equipment, identifying them as acceptable and unacceptable. The U.S. EPA has already identified bans on the use of certain refrigerants in some sectors, such as automotive, in the ruling announced July 2015. And in certain cases the bans have already taken effect, such as supermarket refrigeration.



In addition to other changes that impact various sectors, specific to HVAC, the ruling states that after January 1, 2024 no new chillers (any style/design/compressor/capacity) that use HFC refrigerants such as R-410A and R-134a shall be sold to a United States installation. Some other clarifications about the ruling:

- R-134a and R-410A chillers can continue to be specified and purchased up until January 1, 2024.
- R-134a and R-410A chillers can continue to operate, be serviced and maintained indefinitely—the SNAP ruling does not affect chillers installed before the effectivity date.
- R-134a and R-410A refrigerant can continue to be produced, imported or exported without restriction – the SNAP ruling does not govern refrigerant production. In fact, HFC refrigerant production has not been part of any refrigerant regulation discussions.
- R-134a can continue to be produced as an ingredient in HFO blends (i.e., R-450A, R-513A).
- SNAP does not determine a GWP limit for refrigerants.

## Tips for chiller owners

Here are some tips for chiller owners based on the types of chillers in their facilities:

### For chiller(s) that use HCFC refrigerants such as R-22 or R-123:

- The original Montreal Protocol identified a production elimination date for HCFC refrigerants.
- No new R-123 equipment can be sold after December 31, 2019
- R-514A has been identified as a replacement refrigerant for R-123 chillers. Johnson Controls continues to research and test this refrigerant alternative.
- Due to the refrigerant expense and exceptionally limited track record of R-514A use in air-conditioning applications, Johnson Controls suggests that the best actions today for R-123 chiller owners are:
  - For newer equipment, stock R-123 to guard against price increases and shortages.
  - For older equipment, evaluate the replacement potential based on condition and lifecycle phase, factoring in energy saving opportunities, utility incentives, maintenance and repair costs, and increasing refrigerant costs, which may justify early chiller replacement.

- Good equipment maintenance is critical for avoiding losses which require replacement refrigerant and damage the ozone layer.

### For chiller(s) that use HFC refrigerants such as R-134a or R-410:

- No regulations or discussions have included phase out or complete elimination of HFC refrigerant production. This refrigerant will continue to be manufactured and sold into the foreseeable future.
- The regulation agreements affect the sale of new equipment only and will not go into effect until January 1, 2024.
- There is no need to convert or replace R-134a equipment at this time, unless the equipment itself is at the end of its lifecycle.
- Owners with installed YORK R-134a chillers should know that these units are compatible with the non-flammable, low-GWP refrigerant R-513A. R-513A is a viable solution that offers owners confidence in their 20 plus year investment.
- Johnson Controls will continue its leadership position in sustainability and energy efficiency by providing optimized products.

Although low-GWP refrigerants are starting to appear in the market, all of these refrigerants have trade-offs, some with concerns around flammability and toxicity, some that negatively impact capacity and/or performance and all that are more expensive. The best approach is to invest in real world energy efficiency to have the greatest reduction on global warming potential. Remember, when considering a chiller's total global warming impact, 95 percent or more of its emissions come indirectly from the production of the energy used to operate the chiller, while only 5 percent or typically less is from the global warming potential of the refrigerant used in the chiller. Selecting a chiller that impacts the 95 percent or more indirect effect drastically reduces the chiller impact to the environment. It's best to invest in real world energy efficiency, and even better when the chiller comes standard with the ability to easily convert to a low-GWP alternative in the future.



## Guidelines for decision-making

How do owners and responsible equipment manufacturers make refrigerant choices that are practical, safe, efficient and environmentally friendly? At Johnson Controls, we use our Refrigerant Stewardship Model that evaluates three criteria. This model may also provide useful for chiller owners and operators as they make refrigerant decisions for their facilities.



**Safe & reliable:** Many of the commercial refrigerant alternatives are mildly flammable. In response, mildly flammable refrigerants are being researched and reviewed. So then standards and codes can be developed to establish rules for how equipment and building design must accommodate mildly flammable refrigerants and how the refrigerants can be used safely. New refrigerants must also be tested for reliability to ensure compatibility with HVAC system gaskets, elastomers, and materials of construction. Chiller operating lifespans are typically beyond 20 years, so the refrigerant must prove long-term stability. If a refrigerant begins to break down over time, it can impact system performance and operating costs or cause damage to the equipment.

**Efficient & sustainable:** For refrigerant alternatives to be considered, its use should result in overall chiller performance that is similar to conventional or existing refrigerants. Although the GWP of refrigerant alternatives is lower, a negative impact to performance can result in higher indirect emission values which can end up negating

the position direct effect reduction of the refrigerant's GWP value. The other trade-off that is seen with "dropping in" alternatives is capacity impacts. A new refrigerant that results in lower capacity poses a different challenge: Customers will see higher first costs because larger or additional equipment will be required to meet existing capacity. For both concerns around efficiency and capacity, new refrigerants should result in overall chiller performance that is equal to or better than the fluids they replace.

**Available & affordable:** Alternative refrigerants must be affordable. Many of the emerging refrigerants cost up to five times more than existing fluids. Where flammable refrigerants are being considered, there are the additional costs for the facility safety equipment, increased ventilation requirements, and potentially higher insurance premiums. Refrigerants must also be available. Some of the recently introduced refrigerant alternatives have been released only in limited quantities or, in some markets, not at all. The challenge is understandable; it takes time for new product production to ramp up and for supply chains to be established. But in the meantime, the lack of availability creates incalculable risk. Technicians can't be properly trained in the refrigerant's use. And for building owners who commit to a refrigerant that's not widely available at the outset, the long-term cost of ownership may turn out to be prohibitive if supply remains limited.



### Making informed decisions

Current refrigerants such as R-134a and R-410A offer proven solutions that provide efficiency and safety. The initial movement towards lower GWP refrigerants is no cause for equipment owners or operators to be alarmed. Refrigerants with lower GWPs are being developed and commercialized. The industry and Johnson Controls in particular is working to balance safety, performance, environmental impact, and total cost of ownership for each application.

Johnson Controls is committed to our customers interests and is continuing to lead the way as the industry begins to transition to the next generation of refrigerants. Understanding how new legislation impacts your current and future equipment needs will help you choose the best refrigerants for your facility.



Visit the Johnson Controls Refrigerant Reservoir for the latest news and insights on refrigerants in building equipment and applications: [www.johnsoncontrols.com/refrigerants](http://www.johnsoncontrols.com/refrigerants).

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