



# Going...going...green

## 10 things you should know about HVAC refrigerants and the phaseout schedule

Along with space flight and computers, refrigeration made the “top ten” list of greatest inventions of the twentieth century. Without it, we would not have food preservation as we know it; nor would high-rise office buildings, modern health care facilities or schools

be the comfortable places they are today. But by the mid-1980s, the world recognized that common air conditioning refrigerants were severely damaging the Earth’s ecology. The two refrigerant families most often used in air conditioning systems are

CFCs (chlorofluorocarbons) and HCFCs (hydro-chlorofluorocarbons). The chlorine in these refrigerants damages the ozone layer, and the Montreal Protocol of 1987, an agreement signed by 180 nations, targets CFCs and HCFCs as ozone depleting substances.

The Montreal Protocol requires that CFCs and HCFCs be phased out over a 40-year period that began in 1995 (see sidebar, page 2: Phaseout schedule).

In response to the Montreal Protocol, a new family of refrigerants was developed. HFCs (hydrofluorocarbons, including HFC-134a, HFC-407C and HFC-410A) are ozone-friendly and will not be phased out. So why doesn’t the new refrigerant family solve the problem?

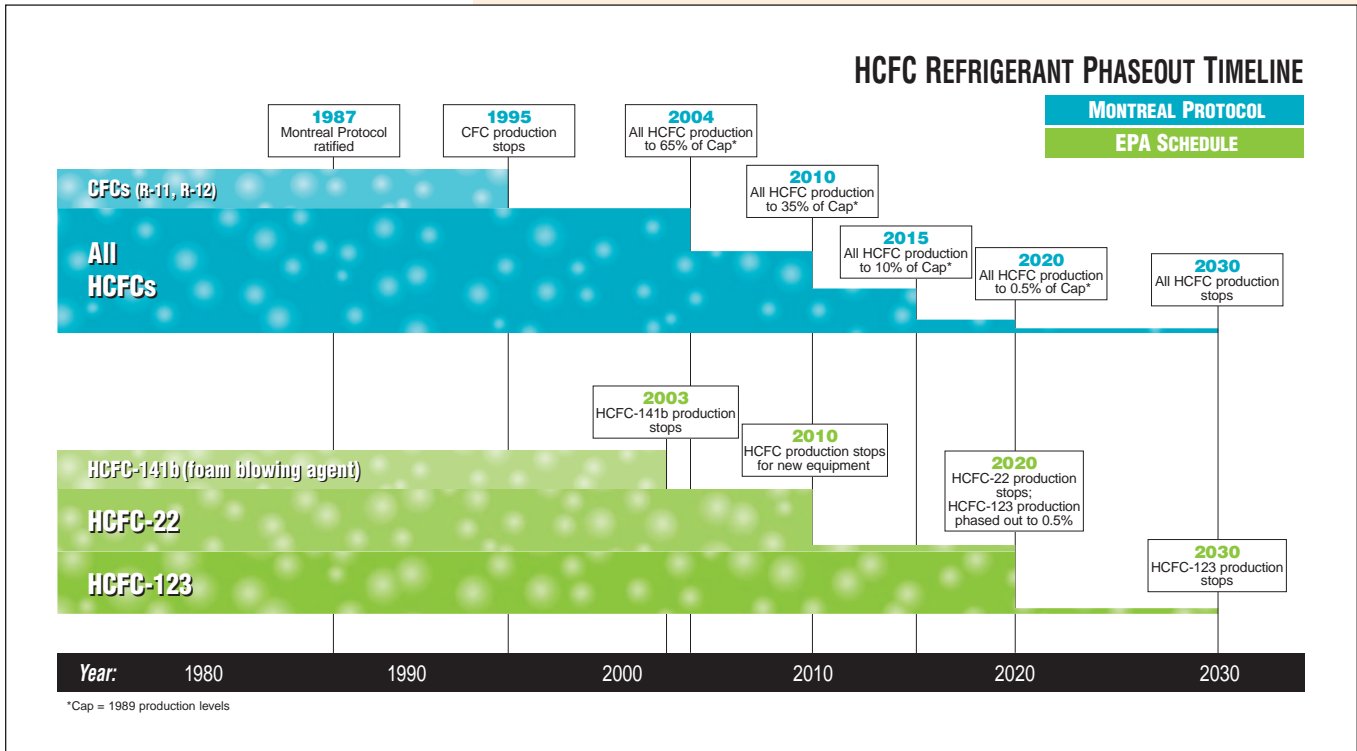
The reason is that the air conditioner you buy today can operate for 20 to 30 years, but if it doesn’t use HFC-134a, HFC-407C or HFC-410A, you may not be able to buy new refrigerant to service it in 16 years.

The refrigerant phaseout requires owners and administrators to take the long view when making decisions about their capital investments.

	2010	2020	2030	Suggested actions
<b>HCFC-22</b>	Available for service only Not available in new equipment	Production stops		1. Service equipment from reclaimed inventory 2. Replace with new equipment using: HFC-410A < 100 tons HFC-134a > 100 tons HFC-407C = DX systems
<b>HCFC-123</b>		Available for service only Not available in new equipment	Production stops	1. Service equipment from reclaimed inventory 2. No replacement currently available

The age of your building’s air conditioning system, the cost to maintain it, and the cost to replace it are all factors to weigh as HCFC refrigerants are phased out. Your best preparation for the future is to take an inventory of the types of refrigerants your HVAC systems use, determine which, if any, are being phased out, and recommend replacement alternatives.





Here are 10 facts and recommendations to help you make those decisions:

## 1. The refrigerant phaseout schedule affects your current and future cooling system decisions.

In accordance with the Montreal Protocol, the EPA will phase out the most common air conditioning refrigerant in the world, HCFC-22, in 2010. As a result, deciding whether to repair existing equipment or replace it – when and with what – are key decisions building owners and facility managers face today and in the future. For example, what is the expected life of your existing equipment and how long will the refrigerant in it be available? If

The phaseout schedule is determined by the Montreal Protocol, the Clean Air Act and EPA regulations

An international treaty, a federal law and federal regulations determine the phaseout of ozone-depleting refrigerants. The current emphasis is the phaseout of HCFC refrigerants, including HCFC-22 and HCFC-123, which still have some chlorine that damages the ozone layer. Production of CFCs stopped under the terms of the Montreal Protocol on December 31, 1995. Now, CFC refrigerants are available only from reclamation – reclaimed refrigerant from systems no longer in operation – and only for servicing systems already in use.

In 2004, production of HCFC refrigerants was limited to 65 percent of the 1989 production level. The next important date on the phaseout calendar is 2010, when HCFC production will be limited to 35 percent of that cap.

The Montreal Protocol treats all HCFCs equally, and does not specify that production of one stop before another. The United States has modified the Montreal Protocol so that substances more dangerous to the ozone layer are phased out sooner, thus allowing more common refrigerants to be produced in larger quantities. This is accomplished under the Clean Air Act of 1992 (Section 604). For example, in 2003 the EPA stopped production of HCFC-141b, a foam blowing agent not used in refrigeration, so that larger quantities of HCFC-22 and HCFC-123 could remain in production.

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you're thinking about a new purchase, what type of refrigerant does it use and how much longer will it be manufactured?

Knowing refrigerant phaseout dates and refrigerant alternatives will help you plan for the future.

## HVAC life expectancy extends beyond the phase-out schedule.

2.

If you buy HVAC equipment today, such as a rooftop unit, it probably will still be operating in 2024,

especially if it's kept in good working order. If your rooftop unit uses HCFC-22, in 2020 you will be servicing it with refrigerant reclaimed from systems no longer in operation. Check with your manufacturer to determine the life expectancy of your equipment and the type of refrigerant it uses.

## Refrigerants have safety classifications.

3.

Refrigerants are chemical substances used for heat transfer in an air conditioning system. Refrigerants absorb heat during evaporation at low temperature and pressure, and release heat during condensation at a higher temperature and pressure. Any refrigerant can be used safely with proper procedures, and any refrigerant can do harm if used improperly. As a basis of comparison, however, ASHRAE Standard 34 classifies the safety level of refrigerants based on their toxicity and flammability. HFC-134a, HFC-407C and HFC-410A are classified as A1 (lower toxicity and no flame propagation). HCFC-123 is classified as B1 (higher toxicity-no flame propagation).



## Efficiency is a function of the system, not the refrigerant.

4.

Chiller efficiency is a function of the entire chiller (compressor, evaporator, condenser, etc). System efficiency is a function of all the components of the air conditioning system (chillers, pumps, towers, air handlers, etc.). Although different refrigerants have different heat transfer properties, a chiller that is rated at 0.5 kW per ton offers this rated efficiency whether it uses HFC-134a, HFC-410A or HCFC-123.

## "Green" refrigerants qualify for LEED points.

5.

The refrigerants used in HVAC equipment can earn a point for LEED certification. A LEED pre-requisite is that HVAC equipment must not use a CFC refrigerant. An additional point can be earned if the refrigerant is not an HCFC (such as HCFC-22 and HCFC-123). HFC-410A, HFC-407C and HFC-134a are considered "green" refrigerants and earn the extra LEED point.

## A molecule of chemistry

For years, CFCs and HCFCs provided the appropriate chemical stability and efficiency required for air conditioning systems. However, they contain chlorine, and chlorine damages the Earth's ozone layer. CFCs and HCFCs are stable molecules and do not react easily with other substances, which gives them a long atmospheric life. This long life allows CFCs and HCFCs to rise high up into the stratosphere where ultraviolet light decomposes the CFC and HCFC molecules and frees the chlorine. Ozone, being reactive, quickly breaks down when exposed to the free chlorine. A single chlorine atom can destroy thousands of ozone molecules, thus thinning the Earth's protective ozone layer.

The concentrations of CFCs, HCFCs and other ozone-depleting substances in the lower atmosphere peaked in 1994 and are now slowly declining. Recent evidence suggests that concentrations in the stratosphere may also have peaked. The ozone layer is expected to return to pre-industrial levels by the middle of this century.



HFC refrigerants, such as 134a, are the newest generation of refrigerants. They replace ozone-depleting HCFCs, and are expected to become the most popular refrigerants in the world. All positive pressure centrifugal chillers and screw chillers are now being designed for R-134a.

### 6. HFC-134a, HFC-407C and HFC-410A are efficient and available for the foreseeable future.

HFC-134a, HFC-407C and HFC-410A have lower toxicity and no flame propagation. They also have no phaseout date, do not contain chlorine, and have no ozone depletion potential.

### 7. HCFC-22 is still widely available, but future support will decrease.

While it is currently the most popular and versatile refrigerant in the world, HCFC-22 cannot be used in new equipment after 2010. A small amount will be manufactured to service equipment until 2020, when its production will stop completely.

If your equipment runs on HCFC-22, you can continue to operate it for its useful life, even after the phaseout date. Like all “extinct” refrigerants, HCFC-22 is grandfathered in the United States. Once the HVAC systems are in the field, they can stay in the field. Because HCFC-22 is so popular, there should be enough reclaimed refrigerant for service and repair.

### 8. HCFC-123 is available for new equipment until 2020.

Used almost exclusively in negative pressure centrifugal chillers, HCFC-123 replaces CFC-11. You will be able to operate HCFC-123 equipment for its useful life, but HCFC-123 will not be available for new equipment after 2020. From 2020 to 2030 it will be available only for service, and after 2030 only from reclamation.

### Global warming and the Kyoto Protocol

About one third of the energy in the U.S. is consumed in the operation of buildings. The energy used to operate a refrigeration system comes primarily from burning fossil fuels. The carbon dioxide released in this process contributes to global warming. The more efficient the refrigeration system, the less carbon dioxide released.

The 1997 Kyoto Protocol is intended to regulate greenhouse gases and the resulting effect of global warming on the Earth’s atmosphere (the Montreal Protocol attempts to protect the ozone layer by preventing the direct release of refrigerants into the atmosphere). Ratifying countries agree to cut their emissions of greenhouse gases between 2008 to 2012 to levels that are 5.2 per cent below 1990 levels. The United States has not ratified the Kyoto Protocol.

The Kyoto Protocol puts HFCs – including R-134a – in a “basket” of six greenhouse gases whose collective emissions must be reduced. There is no phaseout date for HFC-134a, and it is expected to be the main large capacity refrigerant in the HVAC industry for the foreseeable future.



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**9.** “Green” refrigerants are available today for both large and small systems.

Large cooling systems, including all positive pressure centrifugal and screw chillers, are now being designed for HFC-134a and HFC-407C. In small systems – those under 100 tons – HFC-410A has become the main replacement for HCFC-22.

**10.** Take action for the future.

The age of your building’s air conditioning system, the cost to maintain it, and the cost to replace it are all factors to weigh as HCFC refrigerants are phased out. Your best preparation for the future is to take an inventory of the types of refrigerants your HVAC systems use, determine which, if any, are being phased out, and recommend replacement alternatives.

Consider the proactive approach: require that new equipment use “green” refrigerants so the equipment you buy today can be supported for its useful life. Moreover, you will have taken a big step toward restoring the Earth’s ecology.

