Using sustainability as a tool for business improvement

With the European Union's December 31, 2003 deadline for decommissioning halon fire protection systems fast approaching, the rush to lay claim as the long-term halon replacement "agent of choice" has greatly intensified. For fire protection engineers all over the world, today's challenge is to make sense of the barrage of complex, and sometimes-contradictory claims being made concerning today's halon alternatives, and to make a choice that best serves their companies' – and their stakeholders' – interests.

Central to this debate is the issue of "sustainability." In fire protection, a sustainable technology can be defined as one that extinguishes fires effectively; is economical to install and maintain; and perhaps most important in today's business climate, offers a favorable environmental, health and safety profile—allowing it to be used both today and in the foreseeable future with little or no regulatory restriction. Because fire protection systems are typically built into an infrastructure intended to last for years, there should certainly be a monetary value placed on the choice of a sustainable technology.

However that value is calculated, a clean agent fire protection system of any kind represents a significant investment; as such, it makes little financial sense to invest in a conventional system that you know may have to be replaced 5 or 10 years down the road. Because sustainable technology by definition offers more years of service and lower cost-in-use, more and more fire protection engineers around the world have come to realize that sustainability is no longer a fringe or "feel-good" issue, but a matter of managing and reducing risk—to people, property and their company's economic well-being.

Re-defining sustainability

Since the introduction last year of C_6-fluoroketone, marketed as 3M™ Novec™ 1230 Fire Protection Fluid, the standard of sustainability for halocarbon agents has been raised. C_6-fluoroketone is an advanced halon replacement alternative that provides a significant reduction in greenhouse gas emissions over hydrofluorocarbons (HFCs). It offers a Global Warming Potential (GWP) of one, which is equivalent to the GWP of naturally occurring carbon dioxide – the lowest GWP for any halocarbon alternative to halon. It also has an atmospheric lifetime of *5 days*– compared to years, decades and even centuries for other halocarbon alternatives.

Recently, C_6-fluoroketone received Significant New Alternatives Policy (SNAP) program approval from the U.S. Environmental Protection Agency (EPA), listing the agent as an acceptable substitute for halon 1301 in total flooding applications and halon 1211 in streaming applications, because it "significantly reduces overall risk to the environment." In its notice of

Improvements in environmental properties drive clean agent evolution

For the past 10 years, most regulatory agencies around the world have allowed the use of HFCs for fire protection, with few restrictions—even though these compounds have been identified as "greenhouse gases"—because there simply was no more sustainable halocarbon alternative available. But now that C_6-fluoroketone has been shown to have a more favorable environmental profile, will HFCs still be allowed in the years to come, except for a few minor niche applications?

Recent history shows that regulatory restrictions on once-acceptable halon replacements have become tighter, whenever a more sustainable alternative could be found.

Take, for example, what happened with perfluorocarbon (PFC) clean agents. When halon production was first banned, 3M brought a PFC clean agent called 3M™ CEA-410 to market. PFCs are non ozone-depleting, but have a high Global Warming Potential; thus, when it was determined that HFC-227ea could offer a 59% reduction in greenhouse gases compared to PFCs, 3M agreed with policy makers and regulators that PFCs were no longer sustainable solutions in fire protection, and removed them from the market.

Today, a new 3M technology—C_6-fluoroketone—takes greenhouse gases to an all-time low: 99.97% less than HFC-227ea. Although no one can predict what will happen in the future, current regulatory activity is moving toward reducing greenhouse gases—a critical consideration for fire protection engineers who are concerned about the long-term viability of their systems.

Halons

↓

PFCs
Benefit: 100% reduction of ozone-depleting substances

↓

HFC-227ea
Benefit: 59% reduction of greenhouse gases
--End result: PFCs removed from market

↓

C_6-fluoroketone
Benefit: 99.97% reduction of greenhouse gases
--End result for HFCs…?

Environmental Properties of Halon 1301 and Alternatives

Properties	Halon 1301	**Novec 1230**	HFC-125	HFC-227ea	HFC-23
Ozone Depletion Potential (ODP)	12.0	**0.0**	0.0	0.0	0.0
Global Warming Potential–IPCC 2001[1]	6900	**1**	3400	3500	12,000
Atmospheric Lifetime (Years)	65.0	**0.014**	29.0	33.0	260
SNAP (Yes/No)	N/A	**Yes**	Yes	Yes	Yes

[1] IPCC Intergovernmental Panel on Climate Change.

acceptability under the SNAP program, the U.S. EPA stated the following about C_6-fluoroketone:

> *"EPA has reviewed the potential environmental impacts of this substitute and has concluded that, by comparison to halon 1301 and other acceptable substitutes, C_6-perfluoroketone significantly reduces overall risk to the environment...C_6-perfluoroketone provides an improvement over use of halon 1301, hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) in fire protection. [The EPA] find[s] that C_6-perfluoroketone is acceptable because it reduces overall risk to public health and the environment in the end use listed."*[1]

And a recent report prepared for the UK Department of Environment, Food and Rural Affairs concluded,

> *"A new fluorocarbon product (a C_6 ketone) has been commercially available since April 2002. This product is characterised by having a low global warming potential (GWP). . . and is said to perform in a manner similar to other fluorocarbons (and could probably be used in all current and future applications)."*

HFCs, on the other hand, have been identified in the Kyoto Protocol as greenhouse gases targeted for emission reduction because of their high global warming potential.[2] A number of countries around the world have already taken action on the use of these compounds (see sidebar on page 6).

Recently, the United Nations Environment Programme (UNEP) Intergovernmental Panel on Climate Change (IPCC) proposed collaborating on a special report with the Technology and Economic Assessment Panel (TEAP).[3] This report addresses safeguarding the ozone layer and the global climate system by considering the role of HFCs and perfluorocarbons (PFCs) as greenhouse gases.

As alternative technologies with low climate impact, such as C_6-fluoroketone, become available, it is likely that regulatory pressures on HFCs will increase, potentially limiting the useful life of systems based on these compounds. Companies will have to decide whether it is worth the risk to invest in a fire protection system based on HFCs, a currently acceptable alternative subject to regulatory attention, rather than choosing a sustainable technology with low climate impact.

The facts about "non-emissive" applications

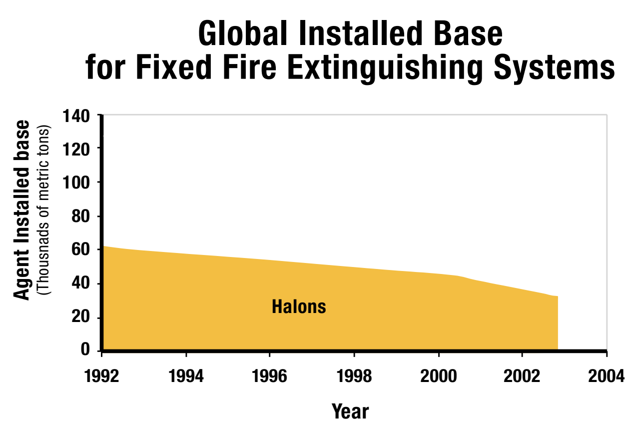
Given the outstanding environmental properties of C_6-fluoroketone over any other halocarbon agent, there would seem to be little room for compounds such as HFCs to make a case for their own sustainability. And yet, one still hears the argument that the use of HFCs in a fire protection system should be considered a "non-emissive application," and therefore not a contributor to greenhouse gas emissions. This same argument was used with respect to halon 1301 in the mid-1980s.

The difficulty with this argument is that, in the real world, there is no such thing as a totally "non-emissive" fire protection system. Despite stringent controls and procedures, emissions still regularly occur during storage, servicing and re-charging. Much is also emitted due to false discharges. And, of course, a certain amount is emitted each year in actual fire extinguishments.

Acknowledging the reality that inadvertent emissions from fire protection systems are a real source of emissions, a number of voluntary initiatives have been put in place to help keep them in check. For example, the Voluntary Code of Practice for the Reduction of Emissions of HFC & PFC, developed by industry groups FEMA, FSSA, HARC and NAFED in conjunction with the U.S. EPA, seeks to reduce emissions by promoting a variety of "best practices." These include increased recovery and recycling of agents; improved maintenance procedures to reduce leakage; use of improved storage equipment to reduce leaks; improved detection and control systems to minimize false discharges; more regular inspection and maintenance; and improved operator training. The Code calls for documenting the results of these initiatives through expanded data tracking and reporting.[4]

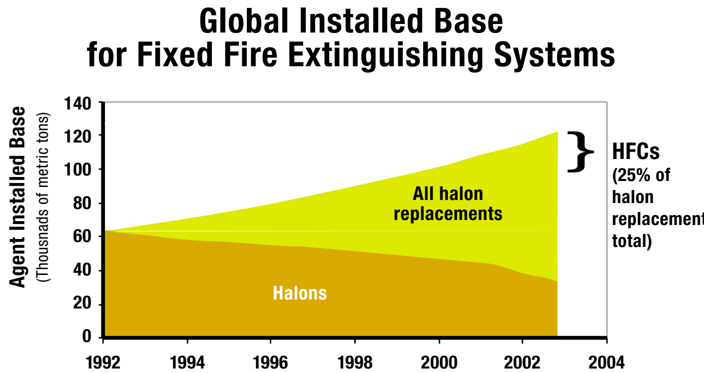
No one is claiming, however, that 100% of emissions can ever be eliminated. The question becomes, how significant are the emissions that do occur?

The Halon Technical Options Committee (HTOC), part of UNEP's Technology and Economic Assessment Panel, estimates that currently about 5% of the installed halon base in North America and Europe is emitted annually, and about 3% in Japan.[5] Using these figures as a guide, the annual amount of HFCs emitted from fixed fire protection systems can be estimated in the following manner:



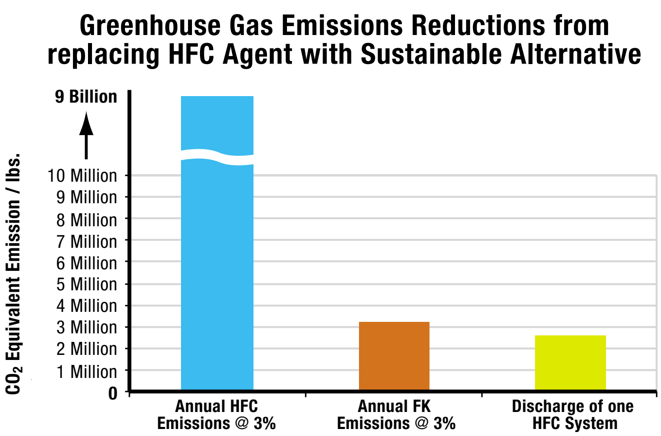
The first step is to determine the volume of halon 1301 that was installed in 1992—the peak year of its use, and just prior to the ban on its production. This amount is estimated to have been about 62,000 metric tons (through decommissioning, that amount will have dropped to about 33,000 tons by the end of 2003).[6]

Even though the amount of halon in service has dropped since 1992, the number of special hazards protection systems has grown at an estimated rate of 6.6% of new extinguishing capacity per year.[7] The following chart shows the amount of halon replacements of all kinds estimated to have been installed since 1992. Although these halon replacements include not-in-kind technologies, such as CO_2 and sprinklers, in addition to halocarbon agents, the numbers indicated on the graph are expressed in terms of their halon equivalency.



Industry sources generally agree that about 25%, or 23,000 metric tons (50.5 million lbs) of current global halon replacement capacity is comprised of HFCs.[8] Because this figure is expressed in terms of halon equivalency, one has to multiply that amount by 1.7 to determine the actual amount of HFCs currently installed (based on the assumption that it requires about 1.7 lbs. of HFC to replace 1 lb. of halon).[9] Thus, in 2003 there are approximately 85.8 million lbs of HFC installed in fire protection systems around the world.

Using the HTOC's low estimate of 3% annual emissions from halon systems, we can therefore infer that 2.6 million lbs. of HFCs are emitted annually. HFC-227ea is the predominant HFC installed in fire protection. Its GWP of 3500 means that 1 lb of HFC is equivalent to about 3,500 lbs. of CO_2. Consequently, the annual amount of HFC emissions expressed as CO_2 equivalent is more than 9 billion pounds.



To put these figures in perspective, consider that the average passenger car in the U.S. emits 10,557 lbs of CO_2 per year.[10] The amount of greenhouse gas emissions from today's installed base of HFC fire protection systems, therefore, is equivalent to that given off by 853,810 cars — a fairly substantial amount for a supposed "non-emissive" application!

In contrast, if all of those systems were charged with C_6-fluoroketone, the amount of CO_2 emitted would be just over 3.2 million lbs per year, the equivalent of about 305 cars—only slightly more than the amount emitted from a single discharge of one average-size HFC system.[11]

In the years ahead, if materials such as HFCs are placed under restricted use regulations in favor of more sustainable alternatives, how could the costs of owning and operating an HFC-based fire protection system be affected? This is difficult to quantify because of the number of variables involved. However, things like sophisticated emissions controls and containment systems; expensive and time-consuming record keeping; eventual system decommissioning and agent recovery; and agent disposal at the end of a system's useful life are ongoing charges that can add thousands of dollars of non-productive expense over the life of a system.

The hidden costs of non-sustainable technologies

Beyond these kinds of ongoing, measurable costs of using a non-sustainable fire protection agent, there can be a number of less-visible—but still very real—costs and risks associated with the use of non-sustainable technologies. One of the most important of these risks is to a company's reputation for environmental stewardship. Today, customers, shareholders and the general public are more concerned about environmental issues than ever before, and are pushing companies to become more proactively "green." They are searching for ways to reduce their exposure to risk in terms of corporate reputation; future regulatory costs; and lost profits from reliance on non-sustainable technology.

For example, a major U.S. telecom company was in the news recently for voluntarily committing to reduce greenhouse gas emissions, an issue that has assumed a key role in the company's strategic planning. And shareholder resolutions at two major U.S. automakers this year requested that the companies significantly reduce CO_2 emissions by 2012—in large part because these shareholders feel that contributing to the spread of greenhouse gases undermines the companies' competitive positions. In fact, there is a growing realization in all industry segments that a public perception of insensitivity to environmental issues can have a negative impact on a company's sales, stock prices and brand equity.

In the not-too-distant future, it is very possible that regulators will cap total greenhouse gas emissions coming from various manufacturing sectors, companies and even individual facilities. Should this occur, any future emissions from currently-installed fire protection systems could count against a company's emissions allocation. If that fire protection system uses a non-sustainable agent, the greenhouse gas emitted from it could be significant; the company could then be forced to make much more difficult, and costly, reductions (such as CO_2 from energy use) or pay someone else—who did invest in sustainable technologies—for the right to emit.These are just a few examples of how public opinion and regulation are changing our perception of "sustainability" from that of a non-productive expense to a profitable business asset.

A global issue

Clearly, the momentum for policy and regulation on the issue of climate change is coming mostly from outside the United States. And because of this, many U.S. users of HFCs have chosen to take a "wait and see"

In monitoring PFC and HFC regulatory trends, the global fire industry is already beginning to see broad policy, legislative and regulatory trends developing that do not favor HFCs. These trends include:

- In August of 2003, the European Commission advanced a proposal to the European Parliament that included provisions for containment, reporting and marketing and use of fluorinated gases (HFCs) in fire protection. Specifics deal with inspections, leak detection and reporting on emissions and import and export. The proposal also includes the requirement for training and certification programs at the state level to assure compliance. The proposal implies a large indirect cost associated with the future use of HFC fire protection systems.

- In October of 2003 the German Federal Environmental Agency (UBA) officially recognized the innovation of Novec 1230 fluid and is offering financial support for installations utilizing Novec 1230 fluid under the UBA Environmental Investment Initiative.

- The European Commission has also been asked to prepare additional policies and measures to reduce emissions of greenhouse gases. Among the proposals currently being considered are limitations on uses of PFCs and HFCs in various end-use sectors.

- Denmark has put in place an administrative order that bans HFCs, PFCs and SF_6 in various end-use sectors between 2002 and 2007.

- Austria has adopted an HFC Statutory Order that became effective on Jan. 1, 2003, that bans HFCs by specific dates. Phaseout in various end-uses will depend on certain factors, such as the availability of non-HFC technologies.

- The German Environment Ministry has released a paper addressing proposals for HFC controls. The paper could form the basis for policy on HFCs, PFCs, and SF_6. In nearly all cases, there are more environmentally responsible alternatives available. The use ban is based on precautionary and proportionality principles, where they are not indispensable for the protection of life and human health.

- The Norwegian Parliament passed an HFC tax in Norway's National Budget for 2003. Tax rates are based on the global warming potential of the individual compounds, including HFC-227ea.

- The Swiss Environment Ministry has proposed to revise its ozone depletion legislation to include HFCs. HFC extinguishing agents were banned on Jan. 1, 2003.

approach on switching to more sustainable technologies. However, the regulatory trends to reduce HFCs are becoming harder to ignore.

This is especially true for multinational companies, and those with European facilities. In this situation, standardizing on a single, sustainable fire protection solution for their global operations not only offers the potential for significant cost savings through volume purchasing, but also allowing development and maintenance of a single specification. And, of course, the adoption of sustainable technologies can enhance a company's global reputation for environmental stewardship

Although U.S.-based industry has been only minimally affected by policy considerations on greenhouse gases, this is changing. One only has to look at the increase in environmental regulation over the past twenty years to realize this is an issue that is not going to go away.

Compared to past years, there are a wide variety of bills being discussed in Congress regarding proposed U.S. legislation on climate change. Although many of the recommendations call for mandatory action, the Bush Administration's policy on climate change is heavily weighted toward voluntary commitments from U.S. industry. President Bush's plan calls for an 18 percent reduction in the intensity of U.S. greenhouse gas emissions by 2012. To achieve this goal, he is relying upon existing trends and sustainable technology development to play a significant role in greenhouse gas reduction .

C_6-fluoroketone would appear to be the kind of technological advancement to help attain the reduction in greenhouse gas emissions the President is calling for—one that could help the fire protection industry voluntarily reduce their emissions and build a sustainable business that will continue to meet future regulatory trends.

A "win/win" proposition

In the near future, the lifetime cost advantages of choosing a sustainable fire protection system will very likely be extended even further, through the adoption of transferable "emissions trading" credits. These credits would be issued to companies for reducing greenhouse gas emissions below a specified future allocation.

For example, President Bush is supporting and Congress is considering legislation to provide transferable credits for emissions reduction along with providing credit for early action . President Bush's plan would ensure businesses that register reductions today are not penalized under future climate policy, and would provide transferable credits to companies that can show real emissions reductions. It's likely that the Administration will continue to develop incentives for companies to voluntarily reduce greenhouse gases, minimizing reduction costs for businesses. The fire protection industry and its customers will need to consider how their choice of an alternative fire suppression system may qualify as "credit for early action" or allow them to benefit from emissions trading.

Many European countries are further along in developing such programs. Already, a number of global companies headquartered in Europe have instituted internal emissions trading programs as part of their public commitment to reduce greenhouse gases.

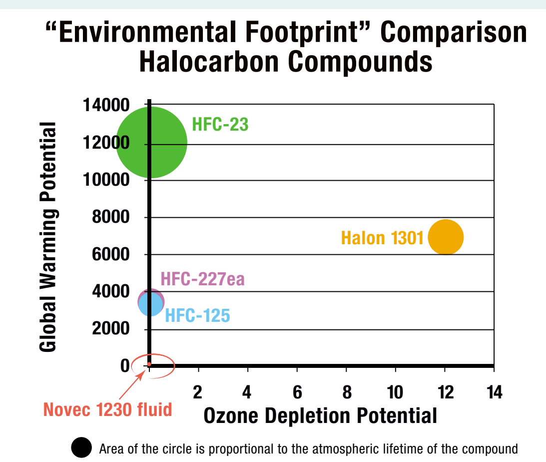
For two such companies, BP and Royal Dutch Shell, these commitments go beyond the reduction targets set by the Kyoto Protocol, and involve trading of emissions credits among various business units. Again, this is not a simple "feel good" program designed to be a public relations exercise, but a means of increasing business value. Shell, for example, has stated that sustainable development is now an "integral part of all business decisions," recognizing that maintaining credibility on sustainability issues is essential to preserving their corporate share value and sales.

The right choice for the long-run

Most observers would agree that global demands to reduce greenhouse gases are not going to subside, and in fact are growing. These demands—expressed in the form of regulation and public opinion—are already having an impact on businesses everywhere, including the U.S. Because of this, forward-thinking companies have made sustainability a key strategy for controlling costs, maintaining shareholder value and reducing business risks.

Policy makers and regulators are continually evaluating alternatives to high global warming compounds—the ultimate goal being to restrict or eliminate the use of these materials wherever a viable alternative can be found. In fire protection, advancements in sustainable halon replacement technology—with 3M™ Novec™ 1230 Fire Protection Fluid (C_6-fluoroketone) for halocarbon agents and Inergen® Clean Agent for inert gases are drawing fresh scrutiny to materials linked to climate change, such as HFCs, and re-writing the standards for "sustainability" in this important application.

For the fire protection engineer, these developments have brought a new clarity to the halon replacement debate, distilling what used to be a complicated and highly-subjective issue down to a simple choice: sustainable…or not sustainable? How you answer that question could have a significant effect on your company for years to come.



Comparing the environmental footprints of halogenated compounds

"Environmental footprint" is a term used to describe the total impact of a given halon replacement on the environment, as measured by its ozone depletion potential, global warming potential and atmospheric lifetime.

In this graphic, the horizontal "X" axis indicates ozone depletion potential, while the vertical "Y" axis shows global warming potential. The diameter of the colored circles represent a product's atmospheric lifetime: the larger the circle, the longer it will reside in the atmosphere.

The least possible environmental impact would be indicated by a small dot at the point where the X and Y axes intersect. As shown here, Novec 1230 fluid—with zero ozone depletion potential, a global warming potential of 1 and an atmospheric lifetime of 5 days—comes closest to meeting this ideal.

References:

1. 67 Fed. Reg. 77932 (Dec. 20, 2002).

2. Kyoto Protocol to the United Nations Framework Convention on Climate Change, United Nations Environment Programme, Nairobi, Kenya, 1997.

3. United Nations Framework Convention on Climate Change, Subsidiary Body for Scientific and Technological, *Relationship between efforts to protect the stratospheric ozone layer and efforts to safeguard the global climate system: issues relating to hydrofluorocarbons and perfluorocarbons*, Item 8 of the provisional agenda Bonn, 4–13 June 2003.

4. Voluntary Code of Practices for the Reduction of Emissions of HFC & PFC Fire Protection Agents, Developed and Endorsed by the Fire Equipment Manufacturers Association, Fire Suppression Systems Association, Halon Alternatives Research Corporation, National Association of Fire Equipment Distributors and the U.S. Environmental Protection Association, March 2002.

5. United Nations Environment Programme, 2002 Assessment Report of the Halons Technical Options Committee, UNEP Nairobi, Ozone Secretariat, Kenya, 2003.

6. Ibid.

7. An average growth rate of 6.6 percent per year is used in this calculation based upon the following data: A large percentage of clean agents are installed for protection of essential electronics (Wickham, R., "Status of Industry Efforts to Replace Halon Fire Extinguishing Agents.") Therefore, the need for fire protection is assumed to grow proportionally with the general economy and the growth of the electronics industry. The U.S. economy grew at a rate of 3.2% per year through the 1990s (U.S. Environmental Protection Agency, "Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2000", Washington, D.C., April 2002.). The electronics industry has reported annual growth rates through the 1990s of approximately 10% (Freedonia Group, Inc.).

8. IPCC (Intergovernmental Panel on Climate Change), Emission Scenarios: *A Special Report of Working Group III of the Intergovernmental Panel on Climate Change*, edited by N. Nakicenovic and R. Swart, Cambridge University Press, Cambridge, U.K., July 2000. The substitution rate of 25% cited in this report is a nominal value. IPCC National Greenhouse Gas Inventory Programme recommends a default value of 35%. Replacement of halon with HFCs in the U.S. is reported to approach 70%. The substitution rate in Japan is estimated to be less than 25%.

9. 59 Fed. Reg. 44248 (Aug. 26, 1994).

10. Assumptions: 1 gallon gasoline = 19.35 lb CO_2 emission; Fuel efficiency for average U.S. passenger car = 22 miles/gallon; Average annual miles driven by U.S. passenger car over first ten years of use = 12,000. Source: U.S. Environmental Protection Agency, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000," Washington, D.C., USA, April 2002.

11. Based upon an average sized halon 1301 system containing 440 lbs, an equivalent sized system using HFC-227ea is reported to contain 767 lbs of agent (Wickham, R., "Status of Industry Efforts to Replace Halon Fire Extinguishing Agents," Report to U.S. EPA, 2002.). A GWP of 3500 results in CO_2 equivalent emissions of 2,684,500 lbs when this HFC agent is discharged.

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