Refrigerant Management

An IHS White Paper on Climate Change and the Bottom Line

Refrigerant management is re-emerging as a highly politicized issue in part due to expanding global climate change legislation. As a result, organizations implementing sustainability strategies are including refrigerant management as an area of focus.

Since the early 1990s, thousands of Chlorofluorocarbon (CFC) and Hydrochlorofluorocarbon (HCFC) systems have been replaced with, or converted to, ozone-safe Hydrofluorocarbon (HFC) refrigerants. As with many operational environmental issues, what was positive from one perspective (better for the ozone) is negative from another (worse for climate change). HFC refrigerants have a global warming potential many times greater than carbon dioxide (CO_2), meaning that a single pound of HFC can equal thousands of pounds of CO_2.

Significant new recordkeeping and reporting rules are coming into effect as early as 2010 in California. Under current law, HFC systems are permitted to leak refrigerant and are exempt from any repair requirements. This is changing rapidly as the U.S. and other federal and regional governments worldwide begin to adopt regulations limiting release of HFC refrigerants.

This paper provides a brief background on the history and current evolution around HFC-based refrigerants and guidance on how companies can best position themselves as a sustainable organization with management and information systems.

"If the EPA walks in, I want to give them that instant Mmm, Mmm good feeling that everything is fine, because it is. Our goal is for all future audits to be done in less than an hour with auditors leaving confident it's done right,"

Environmental Manager,
Campbell's Soup

Refrigerant Trade-Offs

Since the early 1990s, refrigerants have been regulated for their potential to deplete the earth's ozone layer. These materials have been gradually replaced by more "ozone friendly" materials. More recently, the new materials have come under scrutiny for their impact on the global environment.

The Kyoto Protocol, the international treaty for cooperation on addressing climate change, includes refrigerants (fluorocarbons) as a targeted category of Green House Gases.[i] Carbon dioxide is the baseline for global warming potential (GWP) and is defined at 1.0 GWP. Figure 1 below shows the GWP of several refrigerant materials, as well as their corresponding ozone depletion potential (ODP) value.

When refrigerants are compared to CO_2 it becomes very apparent why they are listed as significant contributors to climate change. For example, as shown in *Figure 1*[ii]:

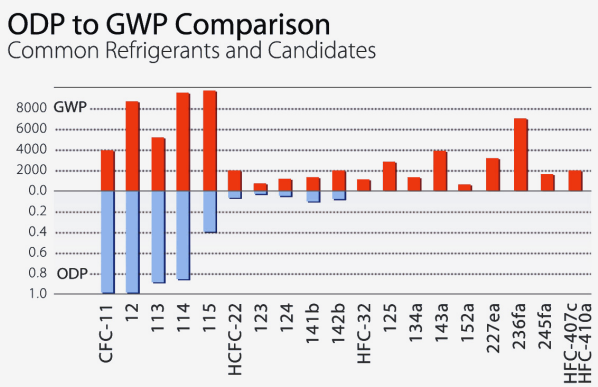
- HFC-134a is a common refrigerant used in most modern refrigerators and automobile air conditioners. It has a GWP value of 1,300 or one pound of HFC-134a which equals 1,300 pounds of CO2.
- R-404A, which is commonly used in grocery store refrigeration, has a sizeable GWP of 3,260. Refrigerants – HFCs (detailed or simplified materials)

The U.S. Environmental Protection Agency (EPA) online climate change calculator[iii] indicates that the average motor vehicle releases 12,100 pounds of CO_2 emissions per year. Putting this into perspective, leaking just one pound of HFC-134a from a car's air conditioning system has the same global warming impact as physically driving the car for a month. Another real-world example is that of a typical chiller with a 3,000 pound operating charge of HFC-134a. A chiller of this size has the potential to release the equivalent of 3,900,000 pounds of CO_2, or an increase in global carbon atmospheric concentration equivalent to a half hour of operations from a large coal fired power plant.[iv]

What was good for one part of the environment (the ozone) is bad for another (climate change). There are always trade-offs in looking at chemicals from an environmental, safety and health standpoint. This is yet another example of how trade-offs challenge the industry.

Existing Global Regulatory Framework

Refrigerants that are used in air conditioning and refrigeration systems have the ability, when released to the atmosphere, to deplete stratospheric ozone, or contribute to global warming, or both. Releases can happen in a multitude of ways: from the point of installation, through service and repair and even to final disposal. For example, see *Figure 2 (opposite page)*, which illustrates a typical leak scenario in which the packing within a refrigerant service valve has failed. The oil staining is indicative of a refrigerant leak.



ODP vs. GWP for refrigerants materials

Figure 1

In the mid-1980s, public attention was directed at the newly-discovered Antarctic ozone hole. In response to the outcry, the Montreal Protocol, was enacted in 1989. This international agreement was designed to phase out the production of ozone depleting substances and ultimately allow for the ozone to fully recover by 2050.[iv] Congress reacted quickly by amending the U.S. Clean Air Act in the early 1990s to address ozone depletion.

Then, in 1995, it became illegal to intentionally vent ozone-safe substitute refrigerants such as HFC-134a. These substitutes posed no threat to the stratospheric ozone layer. They did, however, contribute to global warming and prohibition on intentional release was implemented. This move by the EPA was prophetic because it asserted what is now widely understood; that most refrigerants have a significant global warming potential.

Leaky Valve

Figure 2

"Early adopter" states such as California have begun the process of developing record keeping and reporting requirements that place the same (or more stringent) types of burdens on facilities using global warming refrigerants as were required with ozone-depleting refrigerants. This changing framework is discussed further in the following section.

Changing Regulatory Directions

A. U.S. Federal Government

Since the early 1990s, thousands of CFC and HCFC systems have been replaced with, or converted to, ozone-safe HFC refrigerants. Under current law, these HFC systems are not bound by mandated leak rate thresholds, 30-day time limits for repairs, or repair verification tests. However, changes are occurring quickly. In fact, by the time you are done reading this paper another regulatory update or proposal will have been made.

On December 7, 2009, the EPA officially declared greenhouse gases including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) a danger to human health and well being, making them enforceable under the Clean Air Act.[v] This Mandatory Greenhouse Gas Reporting Rule will affect approximately 13,000 facilities nationwide based on a threshold of 25,000 metric tons of CO_2 equivalent. Emissions data collection and analysis will be required in January 2010, for reporting in March 31, 2011.

B. U.S. Voluntary Programs

Voluntary partnerships between industry and government agencies are also becoming more common.

Climate Leaders is an EPA industry-government partnership that works with companies to develop comprehensive climate change strategies. Partner companies commit to reducing their impact on the global environment by completing a corporate-wide inventory of their greenhouse gas emissions based on a quality management system, setting aggressive reduction goals and annually reporting their progress to EPA. Through program participation, companies create a credible record of their accomplishments and receive EPA recognition as corporate environmental leaders.[vi]

GreenChill, another EPA industry-government partnership, presents an opportunity within the 35,000 supermarkets who continue to use harmful refrigerants. Support is provided to the supermarkets to prepare for deadlines mandated in the Montreal Protocol and other legislative agreements, to prepare for future leak repair regulations and to be recognized for efforts above and beyond actions required under the Clean Air Act.[vii]

C. California

In October 2007, the California Air Resources Board implemented an agenda for public workshop meetings to begin addressing high-GWP refrigerants in stationary sources. When completed, California Global Warming Solutions Act of 2006 (AB 32) will establish registration, record keeping and reporting requirements for most major facilities in the state[viii].

As of August 11, 2009 the most recent draft AB 32 requirements for refrigerant, subject to finalization, effectively:

- Build on Federal Rule Section 608 and South Coast AQMD Rule 1415
- Affect most large facilities with refrigeration systems containing more than 50 pounds of refrigerant (excluding ammonia)
- Annually phase in the facility registration, implementation fees and reporting based on system size starting with 2000 lbs and above on 1/1/2012, then 1999 - 200 lbs on 1/1/2013, and then 199 - 50 lbs on 1/1/2014
- Establish leak detection, repair verification testing, monitoring and mandatory 14-day leak repair requirements (up to 60 days if parts unavailable)
- Implement mandatory retrofit or retirement for unrepaired leaking systems
- Necessitate reporting and record keeping for facilities, distributors and reclaimers
- Include leak detection and monitoring:
    - Leak Inspections and Documentation based on system size
    - Prohibition on “topping off“ systems (adding refrigerant without performing leak detection and leak repair)

California has led in the adoption of aggressive regulatory requirements to address climate change. Often, these requirements may be an indication of what is to come in other jurisdictions.

D. European Union

European Union Environmental Commission (EC) regulations are designed to minimize emissions by phasing out HFC refrigerants, or F-gases, replacing them with low-GWP refrigerants. Starting in 2011, new automobile air conditioning systems will be required to use low-GWP refrigerants. Refrigerant blends that use CO_2 as the main component for cooling are even being studied by researchers worldwide. In fact, German automakers have committed to a full-scale implementation of CO_2-based refrigerants by 2011.[ix]

Leak detection and leak repair requirements are already in place for HFC refrigerants and affect contractors and equipment owners alike. Environmental Commission regulations for EU countries require the elimination of ozone-depleting refrigerants in systems through enforcement of usage bans. For example, if a system leaks its HCFC-22 refrigerant charge, it is illegal to refill that system with HCFC-22 or any other ozonedepleting refrigerant. That system must be converted to an HFC substitute refrigerant, or be replaced by a new HFC-based system.

Management Approaches Required for New HFC Refrigerant Regulations

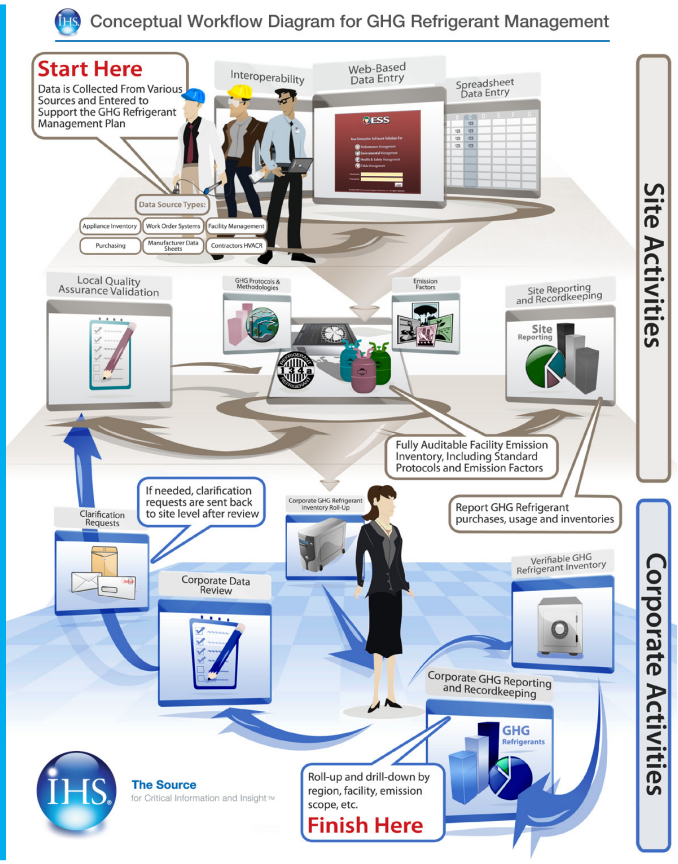
A. Senior Level Commitment Required

Air conditioning and refrigeration systems can be one of those “out of sight, out of mind” items; people do not think about them until a unit malfunctions. Air conditioning units are typically hidden from public view for aesthetic reasons and to prevent excessive noise. The average observer does not notice whether one system is more eco-friendly and efficient than another.

It is important for senior management to help the organization understand the big picture – details regarding the organization’s carbon management initiatives – and then they must know their own day-to-day responsibilities to support the initiative. *Figure 3* shows a conceptual workflow for managing the refrigerant activities within an organization.

Management can help solidify the company's commitment to operational effectiveness by:

- Creating written processes and work instructions for all operating groups, including environmental, operations, contractors and purchasing
- Training all affected personnel to promote understanding of their roles and responsibilities
- Establishing documentation methods to demonstrate conservation efforts
- Implementing the 3 R's of documentation - routing, review and retention
- Allowing assessment by internal and third-party groups to document conservation and sustainability efforts and to identify areas for improvement



Workflow Diagram

Figure 3

This commitment is needed not only to demonstrate organizational environmental stewardship, but also for the economic benefits. Strong management programs can have multiple positive effects in that they save money on increasingly expensive refrigerant materials, while improving energy efficiency and reducing downtime at the same time.

Beale Air Force Base in California is one example of an organization that has realized the benefits of a strong refrigerant management program.[x] Beginning with compliance assessments, then utilizing refrigerant management software and compliance training services, base facility management personnel ultimately received formal recognition of exceptional performance from the Inspector General of the U.S. Air Force. By implementing a refrigerant recycling and monitoring program, the Air Force has saved more than $30,000 in new refrigerant purchases. Additionally, they have reduced operational costs by $15,000 for air conditioning systems on base.

B. Management Processes Needed

Regardless of whether your organization will be affected by California's new HFC-refrigerant regulations or changes to federal Clean Air Act for climate change, there are fundamental components of a refrigerant management program, no matter what the regulatory environment. These components are:

- Establish a baseline inventory for equipment: What refrigerant type is contained in the air conditioning and refrigeration systems at your facility? Is it a CFC, HCFC, or HFC refrigerant? How much is in each system or independent circuit? An important factor to take into consideration is the system condition. This will have an impact on system retrofits or retirement plans for systems once leaks develop.
- Establish a baseline inventory for refrigerants: Weigh each refrigerant cylinder and drum to the ounce. Classify them by condition – new, recovered, recycled, reclaimed, contaminated, fractionated, mixed, etc.

- Standardize a method for documentation of refrigerant-related events:
    - New installations
    - Service and repair of leaks
    - Addition and recovery of refrigerants
    - Disposal of systems, refrigerants and related wastes/oils
    - Contractor and in-house technician certification verification
- Develop and implement a record keeping and reporting tool: Paper method or electronic? Spreadsheet or software? Standalone, network, or Web-enabled?
- Institute refrigerant management guidelines for your organization to include:
    - Policy statements for your facility and specific operations
    - Chain-of-command and assigned compliance responsibilities for all affected personnel – management, technicians, contractors
    - Specific work instructions and processes to aid consistency
    - Communication and training of all affected personnel
    - Self-audit checklists and third-party assessments
    - Records routing, review and retention instructions

Campbell Soup Company's facility in Napoleon, Ohio, has long incorporated environmental stewardship and social responsibility as key corporate values and has committed to playing its part in helping to address climate change.[xi] Addressing CFC, HCFC and even HFC refrigerants using refrigerant compliance management software and onsite consulting services yielded positive results in several ways. The 65-acre, under-roof facility greatly reduced EPA inspection time, improved refrigerant records accuracy and eliminated the negative aspects of a paper-driven record keeping system.

C. Important Role of Information Management Systems

Automated environmental management information systems can be employed by organizations to address documentation and record keeping issues. There are a wide variety of automated tools, ranging from basic desktop, stand-alone systems to globally deployed, web-based powerhouses that support efficient carbon emission management. Regardless of the platform, certain key functions are a must for organizations seeking to fully monitor, optimize and demonstrate their refrigerant conservation initiatives. Important key functions allow the user to:

- Standardize data capture methods with service work orders to become the entry point for environmental record keeping
- Provide automatic alerts when a leak occurs, enabling users to respond promptly to fix the leak before noncompliance occurs
- Track conservation activities like refrigerant recovered/recycled from systems (not vented to the atmosphere)
- Account for legal de minimis losses to the atmosphere, which are associated with trace charges of refrigerant used for leak detection and repair verification
- Identify and document conversion of systems to less harmful refrigerants
- Account for replacement or retirement of obsolete systems
- Document transition to "greener" systems using less energy and low GWP refrigerants
- Provide precise cradle-to-grave monitoring of refrigerant inventories for accurate purchase and disposal
- Record accidental releases due to human error or natural disaster
- Document sustainability in all ways, including migration to environmentally friendly refrigerants, and through conversion, replacement, or retirement of systems

Organizations can achieve savings from unexpected sources; Northern Illinois University avoided a $70,000 motor replacement by tracking all major air conditioning systems on campus in refrigerant compliance management software.[xii] Although purchased for compliance tracking and reporting purposes, the refrigerant foreman saw it as his asset management system. The real value, in his estimation, was the machinery and services tracking. “I can see who worked on what equipment; when and what they were doing in one easy overview.”

Summary

By implementing organizational initiatives and automated record keeping systems, organizations can proactively establish best practices for reducing impact on global warming through improved carbon emission management. Facility owners and managers have the methods and tools within their grasp to begin making a change for the better.

As the White House and Congress shift to a more environmentally-friendly stance, and the EPA considers rule changes to address climate change, organizations will be motivated to broaden sustainability programs to encompass refrigerants. Proactive measures will be seen by stakeholders and investors as a sign of prudent risk management, adding value to an organization and its employees – and the bottom line.

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About IHS

IHS has been in business for over 50 years, providing critical information and insight to governments and companies in a broad range of industries in 180 countries. IHS offers an integrated platform with powerful tools to help your business manage and communicate GHG data for products, supply chain and facilities from the plant floor to the boardroom. IHS software helps organizations to maintain total compliance with EPA regulations by accurately tracking refrigerant usage, leaks, and disposal. It enables organizations to support data collection and reporting for a verifiable carbon emissions inventory; enable strategy development with powerful business intelligence and analysis tools; and helps users execute carbon strategies with performance metrics, tasking and communications.

For more information, please visit www.ess-home.com/Refrigerant or call 1-800-289-6116.

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Thanks to Dave Cox, Dorney Douglass, Steve Faigen, Will Reed, Tevia White and Robert Dennis.

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