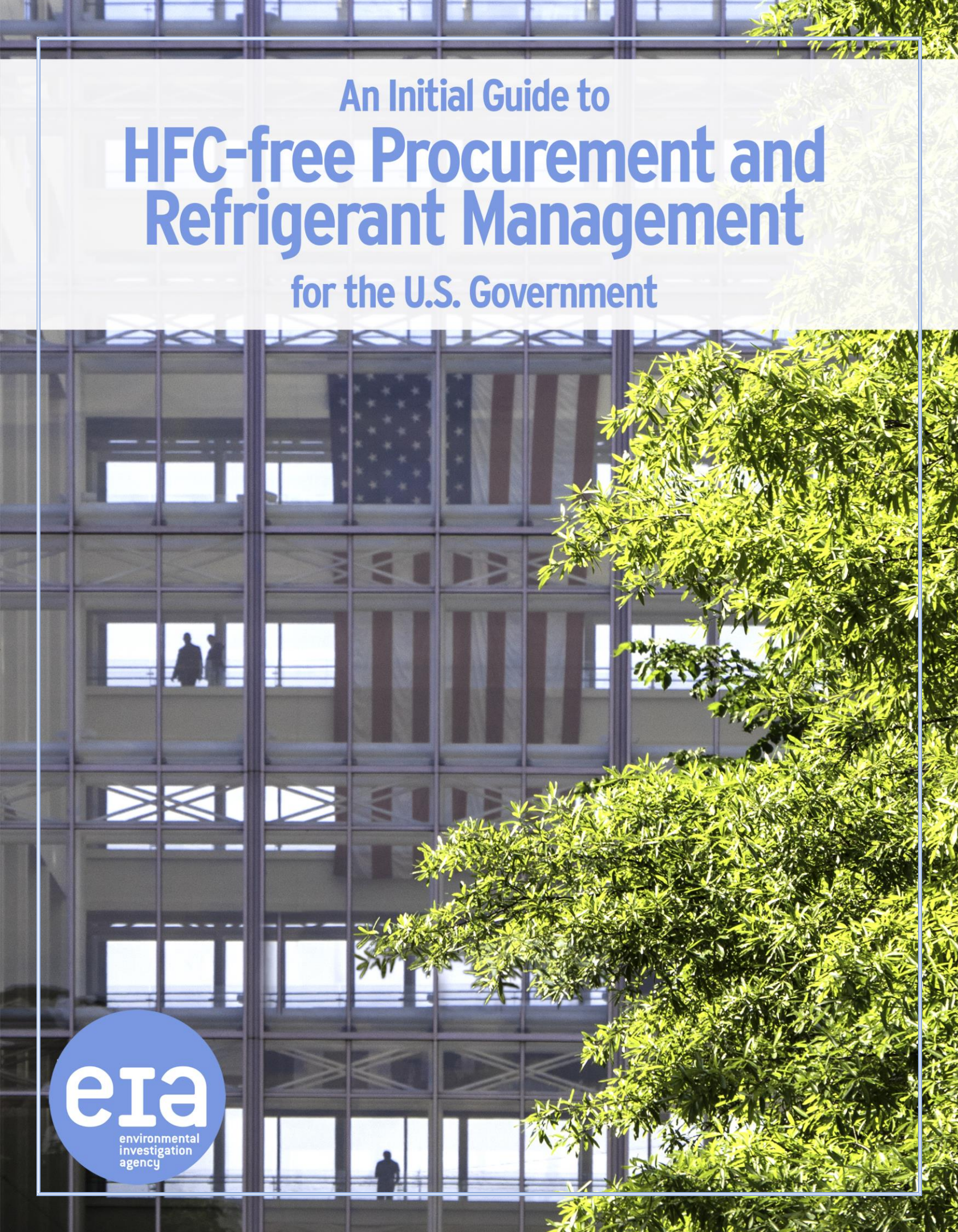


An Initial Guide to HFC-free Procurement and Refrigerant Management for the U.S. Government

environmental investigation agency

ABOUT EIA

The Environmental Investigation Agency (EIA) is an independent campaigning organization committed to bringing about the change that protects the natural world from environmental crime and abuse. As part of our work, we have undertaken groundbreaking investigations into the illegal trade in ozone depleting substances (ODS) and have been closely involved in the international ozone and climate negotiations for well over a decade.



DISCLAIMER

EIA is not affiliated nor does it receive any financial support or any other benefit from any of the companies presented in this Report. EIA acknowledges that there are other companies making alternative HFC-free products, and does not endorse or support the companies represented in this Report nor does the failure to include a company in the Report reflect in any way on that company or its products. All facts stated in this report are based on best available public knowledge as of the date of the publication. EIA has taken reasonable care to check the accuracy and completeness of the content of this Report prior to publication. However, due to the variety of written and on-line sources from which EIA obtained information contained in this Report, EIA makes no representations and gives no warranties as to accuracy, availability, completeness, merchantability, or fitness for any particular product, technology or company presented in this Report. EIA urges all federal representatives engaged in procurement of HFC-free technologies to conduct their own research to ensure that they choose the best technology for their particular use and purpose.

June 2015

©Environmental Investigation Agency 2015

No part of this publication may be reproduced in any form or by any means without permission in writing from the Environmental Investigation Agency.

CONTENTS

Introduction.....1

HFCs: Super Greenhouse Gases.....1

Overview of the Global Policy Landscape on HFCs.....2

International Momentum Builds to Phase-down HFCs.....3

The U.S. Takes Action.....4

Executive Order 13693 –Planning for Federal Sustainability in the Next Decade..5

The EPA's Significant New Alternatives Policy Program.....6

Energy Efficiency Co-Benefits of Procuring Climate-Friendly Cooling Equipment.....6

Key Sectors for HFC-free Procurement.....7

Refrigeration and Air conditioning.....8

Foam Blowing Agents.....8

Fire Suppression.....9

Aerosols and Solvents.....9

Reducing Life-cycle HFC Emissions from Existing Operations.....9

A. State-of-the-art Leak Detection and Control.....9

B. Mandating the Purchase of Certified Reclaimed Refrigerants.....11

Conclusion.....12

Annex 1: Executive Orders and Actions.....15

Annex 2: Agency Programs and Policies.....17

Annex 3: HFC-free Equipment and Products.....20

Introduction

This report is intended to serve as an initial guide* to U.S. Federal government officials engaged in implementing policies to purchase more sustainable alternatives to hydrofluorocarbons (HFCs), as directed under President Obama's Climate Action Plan (CAP).[1] It is also aimed at providing government procurement officers with the resources needed to begin procuring HFC-free technologies. It provides an introduction to the broader international HFC policy landscape and summarizes the existing U.S. policies and agency initiatives that authorize and support HFC-free procurement. The report outlines key sectors where HFC-free equipment and products are available for purchase or acquisition. Additionally, the report provides information on refrigerant management policies that will reduce the overall lifecycle emissions from HFC containing equipment currently in use by federal agencies.

HFCs: Super Greenhouse Gases

HFCs are man-made fluorinated gases developed and commercialized to replace ozone depleting substances (ODS) for use primarily in refrigeration, air conditioning, foam blowing, fire suppression, aerosols, and solvents. They do not deplete the ozone, however they are powerful greenhouse gases (GHGs) with global warming potentials (GWP) hundreds to thousands of times more damaging to the climate than carbon dioxide (CO_2).[2] For example, HFC-404A, commonly used in commercial refrigeration, is almost 4,000 times more damaging to the climate than CO_2. To put this in context, just 1 kilogram of HFC-404A leaking into the atmosphere equates to the climate impact of four tonnes of CO_2.



HFC-404a cylinder. Image: EIA

HFCs are the fastest growing source of GHG emissions in much of the world[3] and after only two and a half decades of commercial production, they represent about 1.7 percent of all global GHG emissions[4], and nearly 2.7 percent of U.S. GHG emissions.[5] Current global projections show HFC emissions growing by at least 8-14 percent annually[6], with growth rates in developing countries at or exceeding 20 percent annually.[7] HFC emissions in the U.S. have increased by 310 percent since 1990 and are expected to triple again by 2030.[8] If action is not taken in the near future, by 2050 global HFC emissions could reach 5.5-8.8 billion tonnes of carbon dioxide equivalent (CO_2e) per year, equaling 9-19 percent of projected global CO_2 emissions under a business-as-usual scenario.[9]

Robust HFC-free procurement and strong refrigerant management policies by the Federal government will support the movement towards a global phase-down of HFCs under the Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol), help the United States meet its international commitments to reduce greenhouse gas (GHG) emissions by 26-28 percent below 2005 levels by 2025[10], and increase the energy efficiency of federal buildings and operations. The government's leadership in purchasing HFC-free equipment will also incentivize the creation of needed infrastructure that will facilitate the adoption of HFC-free equipment and products throughout the U.S. market leading to significant reductions in U.S. HFC emissions.

* New technologies are being proven and commercialized at a rapid rate. The U.S. government's procurement policies should be flexible and continue to evolve as these new technologies enter the market.

With continued direction from President Obama and guidance from existing executive orders and actions, in addition to agency-specific policies and programs, there are many opportunities for the Federal government to lead the rest of the country in the use of HFC-free technologies in equipment and products, and to reduce lifecycle emissions of HFCs. This document lays out opportunities for the Federal government to:

1. Meet the goals outlined by the President by incorporating HFC-free technologies and products into existing procurement programs and policies;
2. Purchase natural and not-in-kind alternatives to HFCs; and
3. Reduce life-cycle HFC emissions in existing equipment.

Overview of the Global Policy Landscape on HFCs

A global phase-down of HFCs is one of the fastest and most cost-effective climate change mitigation options currently available. Reducing the global demand and use of HFCs by transitioning to more sustainable, energy efficient, HFC-free alternatives can help avoid as much as 200 billion tonnes of CO_2-equivalents and 0.5 degrees Celsius warming by the end of the century[11], contributing significantly to climate stabilization efforts. The fastest way to achieve a global phase-down of HFCs is to amend the Montreal Protocol.

The United States has been a primary proponent of an amendment to the Montreal Protocol and, in conjunction with Canada and Mexico, has submitted a joint amendment proposal every year since 2009, to phase-down the production and consumption of HFCs globally.[12]

An HFC-free procurement policy by the Federal government would significantly support U.S. efforts to reduce consumption of HFCs globally, while also act to promote more rapid development of the U.S. market for HFC-free technologies. The Federal government is the single largest consumer of goods and services in the United States[13] and the United States is one of the largest HFC consumers in the world.[14] As a result, there is a significant opportunity to utilize the Federal government's purchasing power to mitigate federal HFC emissions and act to energize the U.S. market for HFC-free technologies and products.



Meeting of the Parties to the Montreal Protocol in 2012. Image: EIA

Fortunately, climate-friendly, energy efficient, HFC-free technologies are becoming increasingly available for nearly all equipment and products that currently rely on HFCs. As these technologies become more readily available in the U.S. market, the Federal government has the opportunity to play an essential role through its procurement policies to expand market development and penetration. Taking action through federal procurement of HFC-free equipment and products will not only result in bolstering international efforts to phase-down HFCs and considerable decreases in U.S. emissions of HFCs, but will also lead to significant increases in energy efficiency throughout federal operations.

International Momentum Builds to Phase-Down HFCs

The Montreal Protocol on Substances that Deplete the Ozone Layer

The Montreal Protocol was created in 1987 to eliminate the use of chemicals that were discovered to be destroying the ozone layer. By 2011, the 197 Parties to the Montreal Protocol had reduced their consumption of ozone depleting substances (ODS) by 98 percent[15], in accordance with its strict and binding schedules in both developed countries ("Article 2 Parties") and developing countries ("Article 5 Parties"). In fact, the Montreal Protocol has been deemed one of the most successful multilateral environmental agreements as a result of this rapid reduction in both consumption and production of ODS. As an added benefit, the phase-out of ODS has accomplished more to mitigate climate change than all other international environmental efforts combined, with cumulative emission reductions of 135 billion tonnes of CO_2 equivalent between 1989 and 2013.[16]

However, because commercialization of HFCs was a direct result of the Montreal Protocol's mandated phase-down of ODS, the climate benefits previously achieved could be significantly offset by the growth in HFC emissions over the coming decades.[17] The Montreal Protocol has a duty to eliminate HFCs, so that it will not have saved the ozone layer at the expense of the global climate. Proposals to amend the Montreal Protocol to phase down HFCs have been blocked since 2009, but recently momentum has begun shifting towards negotiating an agreement to phase out HFCs under the Montreal Protocol.[18]

Amendment on the Horizon

In September 2013, leaders of G20 countries agreed to utilize the expertise and institutions of the Montreal Protocol to phase down HFCs.[19] Recently, President Obama met with President Xi Jinpeng of China[20] and Prime Minister Narendra Modi of India[21]—two countries historically opposed to the amendment proposals—to increase cooperation and build support for an amendment to phase down HFCs through the Montreal Protocol.



President Obama and Indian President Modi. Official White House photo by Pete Souza

In November 2014, the annual Meeting of the Parties to the Montreal Protocol delivered much progress. Although an amendment proposal was not agreed upon, the Parties agreed to hold a workshop on HFC management, including a special focus on low-GWP alternatives for high-ambient regions. The Parties also decided to have an extraordinary Open-Ended Working Group (OEWG) meeting focusing on HFC management within the confines of the Montreal Protocol. The workshop and the OEWG concluded in late April 2015, and progress towards an amendment continued, as India[22], the European Union[23], and a group of small island nations[24] submitted amendment proposals, in addition to the African Group signaling strong support for an amendment.[25] These actions demonstrate there is significant momentum towards managing HFCs under the ambit of the Montreal Protocol. An amendment would lead to huge reductions of approximately 200 billion tonnes CO_2e.[26]

Countries Around the World Take Action

Last year marked the introduction of new landmark regulations limiting the use of HFCs and encouraging the use of alternatives around the world. In April 2014, the European Union (EU) adopted an ambitious regulation to control fluorinated gases, which phases down the consumption of HFCs by nearly 80 percent by 2030 and imposes sector bans on the use of HFCs.[27] Canada has initiated plans to phase down HFCs and impose sector bans in proposed Regulatory Measures on HFCs.[28] Japan has also proposed legislation to reduce domestic HFC emissions and is providing substantial finance for subsidies directed at incentivizing natural refrigerants.[29] These measures are sending regulatory signals to industry making it clear that HFCs are dead-end technologies, and if businesses desire to maintain their market shares in the long term, they must shift production to next generation HFC-free equipment and products.

The U.S. Takes Action on HFCs

As the U.S. Department of State continues its amendment efforts with Canada and Mexico to phase-down HFCs in the international policy sphere, the Federal government has also signaled its strong commitment to mitigate domestic HFC emissions through regulations and actions. Phasing down HFCs in the U.S. has become a priority of the Obama Administration, as outlined in his June 2013 Climate Action Plan[30] and recent executive actions (Annex 1).[31] With the Administration directly targeting the use of HFCs, in addition to new and existing agency policies and actions on GHG mitigation and energy efficiency improvements, federal agencies have a significant opportunity to be leaders in the national effort to phase-down the use of HFCs and promote market development of low-GWP, energy efficient HFC-free equipment and products.

The President's CAP directs the Environmental Protection Agency (EPA) to use its authority through its Significant New Alternatives Policy (SNAP) program to encourage private sector investment in low-emissions technology by identifying and approving climate-friendly chemicals, while prohibiting certain uses of the most harmful chemical alternatives considered to pose a risk to human and environmental health (Refer to EPA SNAP box below).[32]



Official White House photo by Pete Souza

In addition to directives to the EPA, President Obama, through his CAP, has directed all federal agencies to "*purchase cleaner alternatives to HFCs whenever feasible and transition over time to equipment that uses safer and more sustainable alternatives*."[33] In September 2014, in a subsequent announcement on HFCs, President Obama reinforced his statements in the CAP by taking several executive actions (outlined in Annex 1) and partnering with private sector companies that pledged new commitments to decrease emissions of HFCs in the United States.[34] Additionally, President Obama's most recent executive order on March 25, 2015, *Executive Order 13693 - Planning for Federal Sustainability in the Next Decade*[35], will play a pivotal role in providing agencies with the guidance needed to begin procuring climate-friendly, energy efficient, HFC-free equipment and products (Refer to E.O. 13693 box below).

The Department of Defense (DOD), NASA, and the General Services Administration (GSA) have already begun to take action on implementing the President's initiatives by recently submitting a joint proposal to amend the Federal Acquisition Regulation (FAR) to implement the President's CAP provision on procuring alternatives to high-GWP HFCs.[36] The proposed rule will allow agencies to better meet the GHG emission reduction goals and reporting requirements of Executive Order 13693.

Related executive actions and various agency programs and initiatives to increase green procurement are detailed in Annexes 1 and 2. These executive actions and agency policies provide significant opportunity and assistance for procuring climate-friendly HFC-free technologies across all federal agencies. In addition, such transitions to HFC-free technologies would also fulfill mandated energy efficiency criteria, as modern HFC-free technologies are also delivering substantial energy efficiency improvements over traditional HFC-based systems.[37] There is

significant opportunity to utilize the federal programs outlined in Annex 2 to encourage and maximize HFC-free procurement. Energy efficient, climate-friendly HFC-free products must be incorporated into the related guidelines, policies, and programs described in Annexes 1 and 2, and those tools need to be available to procurement officers from all agencies.

Executive Order 13693 – Planning for Federal Sustainability in the Next Decade

Executive Order 13693 comprehensively outlines mandated steps for federal agencies to meet GHG reductions and energy efficiency goals. The executive order makes clear that federal agencies have been leaders in the United States to build a clean energy economy and acquisition management will continue to drive GHG reductions and support preparations for the impacts of climate change. The order states that, "Federal agencies have the opportunity to reduce direct greenhouse gas emissions by at least 40 percent over the next decade, while at the same time fostering innovation, reducing spending, and strengthening the communities in which our Federal facilities operate."[38] Furthermore, in Section 3 (i)(ii)(A) of the order it states:

> "The head of each agency shall, where life-cycle cost-effective, beginning in fiscal year 2016, unless otherwise specified:
>
> i) Promote sustainable acquisition and procurement by ensuring that each of the following environmental performance and sustainability factors are included to the maximum extent practicable for all applicable procurements in the planning, award, and execution phases of the acquisition by:
>
> (ii) Purchasing sustainable products and services identified by EPA programs including:
>
> (A) Significant New Alternatives Policy (SNAP) chemicals or other alternatives to ozone depleting substances and high global warming potential hydrofluorocarbons, where feasible, as identified by SNAP;"

As outlined in this procurement document, energy efficient, climate-friendly, HFC-free equipment and products that meet and exceed the guidelines and policies of this Executive Order are already available to replace a significant portion of HFC-based equipment and products used by the Federal government. With an amendment to the Montreal Protocol to phase-down HFCs on the near horizon, procuring HFC-free technologies now, where feasible, acts to greatly complement Executive Order 13693.

The EPA's Significant New Alternatives Policy Program

The Significant New Alternatives Policy (SNAP) program was created under authority of the Clean Air Act to "allow a safe, smooth transition away from ODS by identifying substitutes that offer lower risks to human health and the environment."[39] Under the SNAP program, the EPA evaluates proposed substitutes to ODS and classifies these substitutes as acceptable, acceptable subject to use limits or conditions, or unacceptable.

When developing a new SNAP rulemaking, the EPA is required by the Clean Air Act to consider "atmospheric effects and related health and environmental impacts, general population risks from ambient exposure to compounds with direct toxicity to increased ground-level ozone, ecosystem risks, occupational risks, consumer risks, flammability, and cost and availability of the substitute."[40] Section 612(c) of the Clean Air Act requires the EPA to promulgate rules making it unlawful to replace ODS with substances that "may present adverse effects to human health or the environment where other substitutes have been identified that reduce the overall risk and are currently or potentially available."[41] This provides the EPA with the authority to drive commercial development toward substitutes that present a lower overall risk to human health and the environment, and to change the certification of alternatives when new alternatives enter the market which pose less harm to human health and/or the environment.

The EPA recently finalized a rulemaking listing four climate-friendly natural refrigerants (propane, ethane, isobutane, and a hydrocarbon blend called R-441A) as acceptable in certain end-uses under SNAP.[42] This Rule will open the U.S. market to a range of proven low-GWP alternatives. The EPA has promulgated a parallel regulation which is aimed at removing the SNAP certification for certain high-GWP HFCs in a range of sectors.[43] The rulemaking has already been released for public comment and is expected to be finalized midsummer 2015.[44] These rules demonstrate that the EPA is committed to the President's CAP directive to use its authority under the SNAP program to curb HFC emissions by working to prohibit their placement on the market and encourage the development of climate-friendly HFC-free alternatives.

Energy Efficiency Co-Benefits of Procuring Climate-Friendly Cooling Equipment

The economic recession of 2008 had a significant impact on the U.S. economy and has led to considerable annual federal budget deficits, forcing mandated cuts across government departments and agencies.[45] Confronted with these realities, departments and agencies have been faced with hard decisions on how to cut costs and still provide necessary services.[46] By investing in energy efficient HFC-free equipment, departments and agencies can meet efficiency goals, reduce operating costs,[47] and simultaneously lessen the climate impacts of its buildings and operations.

The Federal government is the nation's largest energy consumer and with more than 350,000 buildings[48] using around 38 percent of all federal energy consumption[49], therefore building efficiency is critical for reducing energy costs. In 2013, the Federal government spent nearly $6.9 billion on energy costs related to the buildings it owns or occupies.[50] Refrigeration and air conditioning (RAC) systems comprise a significant portion of a buildings energy use, with RAC systems accounting for more than 30 percent of a buildings energy use on average.[51]

With new energy efficient HFC-free technologies entering the market[52], potential cost savings associated with investments in HFC-free cooling equipment could be substantial. These savings can have significant positive impacts on budgets, helping to finance additional conversions to HFC-free equipment over time and allowing departments and agencies to allocate more resources to core programs and services.

Equipment using climate-friendly natural refrigerants† and not-in-kind‡ technology have been found to be significantly more efficient in many end-uses than HFC-based systems.[53] These systems are already commercially available in a majority of end-uses (Annex 3), with significant development and new technologies being proven on a rapid basis for the remaining end-uses. Transitioning to these new technologies provides a significant opportunity for the Federal government to mitigate HFC emissions while cutting energy costs.



Department of Energy Secretary Moniz speaking about the importance of energy efficiency. Image: DOE

Not only will procurement of energy efficient, HFC-free cooling equipment lead to reductions in agency and federal-wide energy costs, federal leadership on energy efficiency will raise public awareness about the broad environmental and economic benefits of these products, leading to wider market adoption and significant GHG reductions throughout the United States.[54] Government purchasing power can greatly support piloting, developing, and scaling-up markets for these climate-friendly, energy efficient, HFC-free technologies.

Key Sectors for HFC-free Procurement

This section is intended to serve as a resource for identifying HFC-free equipment and products for inclusion in existing procurement programs and initiatives such as those listed in Annex 2. It provides a brief introduction to each of the major sectors and applications that currently use HFCs and briefly describes the HFC-free alternatives available. This introduction is supplemented by Annex 3, which lists HFC-free product examples for each sector for end uses where they are available. For cross-referencing and ease of use, products in Annex 3 are categorized according to EPA SNAP sectors. In accordance with requirements under the Buy America Act, products manufactured by companies incorporated in the United States are listed where available.

† Natural refrigerants are refrigerants with negligible climate impacts and minimal risks to human health and the environment. The five natural refrigerants are: Hydrocarbons such as propane and iso-butane, carbon dioxide, ammonia, water and air.
‡ Not-in-kind technology means any system that breaks with conventional technologies reliant on gaseous refrigerants used in the vapor compression cycle. There is a wide range of technologies, including: magnetocaloric refrigeration, adsorption cooling, district cooling, and evaporative cooling. Many more emerging technologies are being developed by companies in conjunction with the DOE's Building Technologies Office under its Emerging Technologies program.

The examples provided in Annex 3 are not exhaustive, nor are they an endorsement of any particular technology or company, but rather are intended to demonstrate the wide variety of the HFC-free equipment and products available on the market. It must be noted that there is no single low-GWP alternative refrigerant to replace all uses of HFCs. Additionally, new HFC-free equipment and products are continuously entering the market. This list should be considered a starting place for agency procurement officers, and frequent monitoring of market developments and research on all of the available alternatives should be conducted before choosing a new HFC-free product.

Refrigeration and Air Conditioning

Refrigerants used in refrigeration and air conditioning (RAC) systems currently primarily use climate- and ozone-damaging fluorocarbon refrigerants (chlorofluorocarbon - CFCs, hydrochlorofluorocarbons - HCFCs, and HFCs). The RAC sector comprised nearly 80 percent of total global HFC consumption in 2010[55] and with more than 60 percent of HFC emissions coming from the RAC sector, transitions to HFC-free systems would significantly mitigate U.S. emissions of HFCs.[56]

Emissions occur from leaks during manufacturing, installation, operation, maintenance, and improper disposal of equipment.[57] The U.S. has seen a substantial surge in fluorinated gas emissions with emissions increasing 73 percent between 1990 and 2013.[58] Systems using climate and ozone-friendly natural refrigerants (CO_2, hydrocarbons, ammonia, water, and air) have benign impacts on the climate compared to HFC-based systems and are increasingly available for many RAC end-uses.

HFC-free RAC systems are not only better for the climate and more energy efficient than HFC-based systems, but they also keep operation and maintenance costs to a minimum. Systems using natural refrigerants have been found to have lower operating costs due to less refrigerant leakage, which also leads to lower overall maintenance requirements.[59]

Annex 3 provides a listing of companies offering HFC-free RAC products available and approved for use under EPA's SNAP program in end uses including commercial refrigeration systems, refrigerated display cases, vending machines, commercial freezers, refrigerators, residential room air conditioning units, adsorption chillers, heat pumps, ice machines, and water coolers.

Foam Blowing Agents

Foam blowing agents encompass a wide variety of applications including refrigerators, buildings, automobiles, furniture and packaging.[60] The blowing agent is used to convert the liquid plastic resin into useable open cell or closed cell foam products. Traditionally in the United States, CFCs, HCFCs, and HFCs have been used as foam blowing agents, but other countries have transitioned to climate-friendly alternatives. For example in Germany, a significant portion of the foam sector utilizes natural foam blowing agents, such as CO_2 and ethanol, hydrocarbons, methyl formate and water.[61] As pressure mounts to phase-down HFCs, many companies have transitioned or are planning to transition to natural blowing agents. Additionally, hydrofluoroolefins[62] (HFOs)[§] are becoming available for some foam blowing applications.

[§] Although HFOs have low global warming potentials, there may be other significant drawbacks of their widespread use as an alternative. Many studies call into question the long-term environmental safety of HFO-1234yf, which produces trifluoroacetic acid (TFA), which can be toxic to aquatic organisms in high concentrations, as a by-product of its breakdown in the atmosphere. Some HFOs also use Ozone Depleting Substances as a feedstock to their production. See reference 62 for more details.

Fire Suppression

Currently some fire suppression products use HFCs, yet nearly all fire equipment have climate-friendly low-GWP alternatives already on the market. Fire extinguishing products for Class A (ordinary combustibles), Class B (fueled by flammable or combustible liquids), and Class C (Energized Electrical) fires using CO_2, inert gases (nitrogen, argon), water-atomizing, potassium nitrite, monoammonium phosphate, sodium bicarbonate, and other climate-friendly products are widely available on the U.S. market and sold by several U.S. companies.

Aerosols and Solvents

There are three uses of aerosol products, including consumer, technical, and medical.[63] Consumer aerosols include products such as air fresheners, deodorants, dusters, spray pain, cleaning products tire inflators, safety horns, personal defense sprays and novelty products. Technical aerosol applications include sprays used for commercial and industrial maintenance including dusters to clear dust and lint and other light particulate material from delicate surfaces (photographic negatives and lenses, substrates in semiconductor "chip" manufacture, computer/TV screens, high quality optics, specimens for electron microscopy) and difficult-to-reach places (the inside of Central Processing Unit "towers", computer keyboards, the inside of cameras, photocopiers, ATMs); freeze sprays; flux removers; mold release agents; and electronic contact cleaners used to dissolve and remove oil, grease, flux, condensation and other contaminants quickly from delicate electronic circuitry and expensive electronic instrumentation.[64] Medical aerosols include inhalers for asthma, wound care sprays, and tissue freeze sprays. Natural alternatives such as hydrocarbons, dimethyl ether, CO_2, and inert gases are already widely used for many kinds of aerosols.[65]

Solvents are used in a variety of products with the largest application being cleaning products, including precision, electronics, and metal cleaning. Alternatives exist for most solvents and nearly all aerosols except for a limited number of medical and technical applications.

Reducing Lifecycle HFC Emissions from Existing Operations

Replacing new refrigeration and air conditioning in government buildings with HFC-free technologies is essential and will generate GHG emission reductions and important market impacts over time. However, there are some immediate and cost-effective steps the government can take to reduce HFC emissions from existing refrigeration and air conditioning equipment in the near-term. In many types of RAC, equipment leak rates of 10-25 percent per year or higher can occur.



Regular maintenance checks can have a substantial impact on efficiency and mitigating HFC emissions due to leaky equipment. Image: DOE

A. State-of-the-Art Leak Detection and Control

Significant benefits can be realized from enacting the best refrigerant management practices. State-of-the-art leak detection and maintenance is essential to prevent HFC emissions, cut down annual costs of refrigerant[66], and ensure the highest energy efficiency from refrigeration and air conditioning equipment.[67] When a system is low on refrigerant, the motor has to work harder to provide the necessary heat exchange and cooling, thus requiring more energy than if the equipment is properly charged.[68] General leak rates in the supermarket industry average about 25 percent of the equipment's refrigerant charge per year, however, those industry leaders

participating in the EPA's Green Chill program[69] routinely achieve leak rates under ten percent.[70] Benefits of refrigerant management practices include: cutting annual refrigerant costs, increasing energy efficiency of existing systems and decreasing energy use, and drastically decreasing emissions of HCFCs and HFCs, as well as indirect emissions of CO_2 due to reduced energy use.[71]

Leak detection systems are of two types: area monitors and leak pin-pointers. Each of these detectors have specific requirements and applications. Area monitors notify when a leak has occurred in a specific area, such as the equipment room, while a leak pin-pointer is used by a professional to check individual joints or components of a system once the area monitor has found a leak.[72] Fluorescent additive can also be injected into the system with oil and leaks can be detected using an ultra violet lamp.[73]

Several American companies manufacture refrigerant leak detection systems including but not limited to: Emerson Climate Technologies[74], Johnson Controls[75], Bacharach[76] and Haloguard[77]. Leakage control is a key element of containment of fluorinated-gases. Companies such as EOS Climate, specialize in providing tools for refrigerant asset management, helping refrigerant users implement data and reporting systems to make sustainable, cost-effective decisions about refrigerant lifecycle management. Tools similar to those provided by EOS Climate and others may also be helpful for improving public management and use of refrigerants.[78]

Instituting leak detection and controls will go hand-in-hand with the President's executive action "updating regulations for service and vendor contractors" that requires contractors to keep track of and report the amounts of HFCs added or removed during routine maintenance, repair, or disposal of any government equipment appliances or supplies. The executive action provides opportunity for agencies to institute a leak detection and control policy with the contractor and is a critical opportunity to decrease refrigerant leakage. If leakage is excessive and cannot be brought under control, it is time to replace the equipment.

EIA recommends the following for best leak management practices:

- All departments and agencies install the appropriate leak detection technology and/or require regular leak detection checks by certified professionals for refrigeration or air conditioning units or buildings using over 25 pounds of refrigerant.
- All departments and agencies publish a detailed state-of-the-art refrigerant management manual focusing on leak detection and monitoring, and system maintenance, as certain precautionary maintenance practices can dramatically reduce leak rates. Systems older than 10 years should be replaced, while systems less than 10 years should be assessed for retrofit and maintenance.
- All departments and agencies require maintenance staff or contractors to be trained to monitor and detect and/or address leaks in all RAC equipment in the facilities they work in. Additionally, strict protocols for monitoring and repairing leaks in in all RAC equipment should be instituted and enforced.
- All federal food retail facilities (commissaries, cold food warehouses, etc.) should exceed and/or meet the EPA's GreenChill Partnership gold or platinum certification standards. New facilities should at minimum qualify for platinum-level store certification and existing facilities should qualify for at minimum gold-level certification.[79]

B. Mandating the Purchase of Certified Reclaimed Refrigerants

Refrigerants will eventually reach their end-of-life requiring the system to be recharged with either new virgin[**] or certified reclaimed[††] gas. Additionally, as described above, refrigeration and air conditioning systems are prone to leaks during normal operations[80] and need to be periodically recharged to ensure efficient and safe operation. Government facilities around the country that have HFC or HCFC-based systems will likely remain in use for the foreseeable future. While minimizing leakage rates should be priority, leaks still will occur, therefore recharging this equipment with certified reclaimed gas will help to prevent GHG emissions and lower climate impacts.

To varying degrees, refrigerants are reclaimed every year from end-of-life refrigeration and air conditioning equipment and during servicing. Since they have been or are being phased out of production, there is increasing demand for reclaimed HCFC refrigerant for servicing older equipment. However, current projections by industry experts expect that demand will outpace supply in the near future.[81]

In contrast to HCFCs, there is little demand for reclaimed HFC refrigerant because of the current abundant supply of virgin HFC gas. Currently, less than 10-15 percent of HFC refrigerants are recovered, reclaimed, and re-used.[82] Without a proper incentive for reclamation, used HFC refrigerants are ultimately released into the atmosphere through venting or leakage, leading to substantial climate impacts. The EPA's proposals to extend Section 608 of the Clean Air Act will aim to address leakage, recovery and reclamation, and disposal of HFCs[83], providing a regulatory incentive to recycle and reclaim HFCs.

Use of reclaimed HFCs to service existing refrigeration and air conditioning equipment displaces new production of virgin refrigerant, thereby directly avoiding GHG emissions that would otherwise occur. For example, *Recycling HFC Refrigerants Delivers Immediate, Cost-Effective Climate Protection* by EOS Climate explains that, "[w]ith relatively small changes in practices and little if any additional cost, HFC refrigerants can be recovered, reclaimed and re-used, potentially avoiding emissions the equivalent of 18 billion tons of CO_2 between now and 2040—a critical window to address climate change."[84] The Federal government can play a central role in aiding in the development of the market for reclaimed HFC refrigerants.

Additional benefits of using reclaimed refrigerant include: reduced risk of hydrolysis, corrosion, or compressor failure; reduced risk of rogue thermodynamic properties in the fluid; optimal equipment operation and energy efficiency; compliance with consumer and legislative demand; and helping to meet sustainability agendas.[85] Moreover, reclaimed refrigerants are often cheaper than virgin refrigerant[86], therefore allowing agencies an opportunity to cut costs. Further, increasing demand for reclaimed refrigerant by government agencies will increase capabilities of the reclamation industry needed to ensure an eventual safe and effective phase-down of HFCs. This is consistent with the objectives of the EPA and industry to increase the rate of refrigerant recycling and improve refrigerant management practices.

A governmental mandate to use reclaimed refrigerants will encourage the expansion of the recycling industry, increase the cost paid to reclaim spent HFCs, and incentivize companies to improve leak detection and

[**] Virgin gas is defined as the new supply of refrigerant produced for its first use in new and retrofit equipment and systems.

[††] In this case, the definition of "certified, reclaimed" refers to HFCs that are:

- Processed by EPA-certified reclaimers to meet virgin-grade purity standards (e.g., ARI 700); and
- Supplied by vendors that have electronic or paper records that document:
    - The source and chain-of-custody of the recovered/reclaimed refrigerant; and
    - The greenhouse gas emission reductions associated with use of the reclaimed refrigerant based on quantification protocol verified by an approved 3rd party.

maintenance so they are not emitting a climate-damaging and costly product into the atmosphere. Additionally, by proactively acting to address the concerns outlined in Section 608 and the EPA's proposals to extend Section 608 to HFCs, federal agencies can both support the EPA's actions, and also substantially reduce GHG emissions and increase efficiencies of current HFC-based systems in use.

EIA recommends that federal agencies enact policies, beginning in 2016, that aim to use at least 40 percent certified reclaimed HFC refrigerants to meet their servicing needs, with that percentage increasing over time. Additionally, agencies should aim to use 100 percent reclaimed HCFC refrigerants. Such action would result in a significant and immediate reduction in HFC and HCFC emissions, while strengthening the ability of the United States to implement a total HFC phase-down.

Such a mandate would also complement the President's executive action requiring contractors to keep track of and report the amounts of HFCs added or removed in government equipment, appliances, or supplies. The list of certified CFC, HCFC and HFC recyclers in the United States is available on the EPA website.[87]

Conclusion

The impacts of integrating HFC-free technologies into Federal government procurement programs will be instrumental in supporting the global market, leading to decreased total emissions of HFCs in the United States and beyond, while also improving upon the energy efficiency of government buildings.

With the tremendous purchasing power of the Federal government, as well as the support of existing programs and policies, federal departments and agencies have the opportunity to achieve President Obama's goals of reducing HFC emissions, while increasing energy efficiency and cutting costs. These actions would also complement the U.S. government's ongoing energy efficiency efforts, GHG mitigation strategies, and resolve to phase-down HFCs internationally and domestically. With the recent proposal by the DOD, NASA, and GSA to amend the Federal Acquisition Regulation in order to begin procuring alternatives to high-GWP HFCs when feasible, the Federal government is making progress towards the President's CAP initiatives and executive actions.

EIA encourages and urges all agencies to incorporate procurement of HFC-free technologies in both existing and new policies and programs. We urge the Federal government to expedite the procurement of climate-friendly HFC-free technologies within their own green procurement initiatives and implement measures to reduce lifecycle emissions from existing equipment. EIA also encourages the Federal government to set effective goals for HFC-free buildings. Furthermore, we challenge all agencies to have revised their procurement policies and rules adopted by June 30, 2016.

Deploying energy efficient, climate-friendly, HFC-free technologies and lifecycle refrigerant management is no longer a challenge, but an opportunity to show U.S. leadership that must not be missed.

References

1. The White House. *FACT SHEET: Reducing Greenhouse Gas Emissions in the Federal government and Across the Supply Chain*. 3/19/15. Web. 6/5/15
2. UNEP Working Group I. *2.10.2 Direct Global Warming Potentials - IPCC Fourth Assessment Report: Climate Change*. United Nations Environment Program, 2007. Web. 8/25/15.
3. Monroe, Robert. *Fast Action to Cut HFCs Avoids Up to 0.5°C of Warming by the End of Century.* Scripps Institution of Oceanography, UC San Diego. 6/26/13. Web. 6/5/15.
4. World Resources Institute. *CAIT Climate Data Explorer*. Web. 6/5/15. 1.7 percent was calculated using global 2011 total f-gas emissions and 2011 total GHG emissions.
5. EPA, *Overview of Greenhouse Gases.* 5/7/15. Web. 6/5/15.
6. Velders G.J.M. et al. *The Large Contribution of Projected HFC Emissions to Future Climate Forcing*. 5/14/09. Web. 6/5/15.
7. Montzka, S.A. *HFCs in the Atmosphere: Concentrations, Emissions and Impacts.* Web. 6/5/15.
8. EPA. *EPA's Significant New Alternatives Policy (SNAP) Program and Hydrofluorocarbons.* DOE FEWG/CAWG Web Teleconference. 11/14/13. Web. 6/5/15.
9. Supra 6. Velders
10. The White House. *FACT SHEET: Reducing Greenhouse Gas Emissions in the Federal government and Across the Supply Chain*. 3/19/15. Web. 6/5/15
11. Xu Y., Zaelke D., Velders G. J. M., & Ramanathan V. (2013) *The role of HFCs in mitigating 21st century climate change*. Atmospheric Chemistry and Physics. 6/26/13. Web. 6/5/15; see also Ramanathan V. & Xu Y. (2010) *The Copenhagen Accord for limiting global warming: Criteria, constraints, and available avenues*. 3/26/10. Web. 6/5/15.
12. Department of State. *United states, Canada, Mexico Submit North American HFC Phase-down Amendment to the Montreal Protocol.* 5/9/14. Web. 6/5/15.
13. EPA. *Environmental Preferable Purchasing (EPP).* 5/7/15. Web. 6/5/15.
14. World Bank. *HFC gas emissions*. 2010. Web. 6/5/15.
15. EIA. *The Montreal Protocol in 2012: Ending the Reign of Fluorocarbons, Answering the Call on Climate*. 7/23/12. Web. 6/5/15.
16. UNEP, MLF. *OzoNews*. 12/30/14. Web. 6/5/15.
17. Id.
18. EPA. *Recent International Developments Under the Montreal Protocol.* 7/11/14. Web. 6/5/15.
19. The White House. *United States, China, and Leaders of the G-20 Countries Announce Historic Progress Toward a Global Phase-down of HFCs.* 9/6/13. Web. 6/5/15.
20. The White House. *U.S.-China Joint Announcement on Climate Change.* 11/11/14. Web. 6/5/15.
21. The White House. *Fact Sheet: U.S. and India Climate and Clean Energy Cooperation*. 1/25/15. Web. 6/5/15.
22. UNEP. *Proposed Amendment to the Montreal Protocol Submitted by India*. 4/30/15. Web. 6/5/15.
23. UNEP. *Proposed Amendment to the Montreal Protocol Submitted by the European Union and its Member States.* 4/30/15. Web. 6/5/15.
24. UNEP. *Proposed Amendment to the Montreal Protocol Submitted by Kiribati, Marshall Islands, Mauritius, Micronesia (Federated States of), Palau, Philippines, Samoa and Solomon Islands*. 5/4/15. Web. 6/5/15.
25. RAC. *India and Africa Sign-Up for HFC Phase-down*. 4/28/15. Web. 6/5/15.
26. UNEP. *Benefits of Phasing Down HFCs Under the Montreal Protocol.* Web. 6/5/15.
27. European Commission. *F-gas emissions to be cut by two-thirds by 2030*. 5/8/15. Web. 6/5/15.
28. Environment Canada. *Consultations Document: Proposed Regulatory Measures on Hydrofluorocarbons*. 2/19/15. Web. 6/5/15.
29. R744.com, *Japan: €36 million in subsidies for natural refrigerants as new f-gas measures loom.* 2/6/14. Web. 6/5/15.
30. Executive Office of the President. *The President's Climate Action Plan*. 6/25/13. Web. 6/5/15.
31. Executive Office of the President Council on Environmental Quality. *Fact Sheet: Obama Administration Partners with Private Sector on New Commitments to Slash Emissions of Potent Greenhouse Gases and Catalyze Global HFC Phase-down.* Press Release. 9/16/14. Web. 6/5/14.
32. Supra 18.
33. Supra 1.
34. Supra 31.
35. The White House. *Executive Order – Planning for Federal Sustainability in the Next Decade*. 3/19/15. Web. 6/5/15.
36. Federal Register. *Federal Acquisition Regulation; High Global Warming Potential Hydrofluorocarbons*. 5/11/15. Web. 6/5/15.
37. Witt, Monika. Eurammon. *Natural Refrigerants: Current Developments and Trends*. Web. 6/5/15; EIA, Greenpeace. *Cool Technologies: A Guide to Working Without HFCS.* Web. 6/5/15; Linde Gas. *Natural Refrigerants*. 2015. Web. 6/5/15.
38. Supra 35.
39. EPA. *Significant New Alternatives Policy (SNAP) Program*, Web. 6/5/15.
40. Clean Air Act. *Significant New Alternatives Policy Program, Agency Review of SNAP Submissions, 40 C.F.R. § 82.180(a)(7)(i)-(ii).* Cornell University Legal Information Institute. Web. 6/5/15.
41. Clean Air Act. *Safe Alternatives Policy, Title 42 Chapter 85 Subchapter VI 7671K.* Cornell University Legal Information Institute. Web. 6/5/15.
42. EPA. *Protection of Stratospheric Ozone: Listing of Substitutes for Refrigeration and Air Conditioning and Revision of the Venting Prohibition for Certain Refrigerant Substitutes.* 2/27/15. Web. 6/5/15.

43. Federal Register. *Protection of Stratospheric Ozone: Change of Listing Status for Certain Substitutes Under the Significant New Alternatives Policy Program; Proposed Rule.* 8/6/14. Web. 6/5/15.
44. Id.
45. Congressional Budget Office. *The 2014 Long-Term Budget Outlook*. 7/15/14. Web. 6/5/15.
46. Federal Times. *Government Cuts 84,500 Federal Employees in Three Years*. 1/20/15. Web. 6/5/15.
47. GSA. *GSA to Increase Energy Efficiency and Reduce Costs in Federal Buildings*. 5/17/12. Web. 6/5/15.
48. DOE EERE. *About the Federal Energy Management Program.* Web. 6/5/15.
49. DOE EERE. *Comprehensive Annual Energy Data and Sustainability Performance*. 2013. Web. 6/5/15. Calculated figure from "Total Energy Consumption by End-Use Sector" pie chart by adding goal buildings percentage and excluded facilities percentage.
50. Id.
51. GSA. *Sustainable Facilities Tool: System Overview.* 2012. Web. 6/5/15.
52. EIA, Greenpeace. *Cool Technologies: A Guide to Working Without HFCS.* Web. 6/5/15.
53. Supra 37; Natural Refrigerants. *Home Page*. Web. 6/5/15; Carrier. *Natural Refrigerants Make Commercial Sense, Carrier Study Says.* 9/8/14. Web. 6/5/15.
54. EPA. *Energy efficient Product Procurement*. 2011. Web. 6/5/15.
55. UNEP, *HFCs: A Critical Link in Protecting Climate and the Ozone Layer*. 2011. Web. 6/5/15.
56. Greenpeace. *HFCs and other F-gases.* Web. 6/5/15.
57. Supra 5.
58. Supra 5.
59. Linde. *Cool by Nature.* Web. 6/5/15.
60. EPA. *Foam Blowing Agents.* 10/28/14. Web. 6/5/15.
61. Proklima, GIZ. *Natural Foam Blowing Agents.* 9/1/12. Web. 6/5/15.
62. Greenpeace. *HFOs: the New Generation of F-Gases.* 10/1/09. Web. 6/5/15.
63. ICF, 2014a. Market Characterization of the U.S. Aerosols Industry. Prepared for the U.S. Environmental Protection Agency. May, 2014.
64. IPCC/TEAP. *Special Report: Safeguarding the Ozone Layer and the Global Climate System, 2005.* Web. 6/5/15.
65. Id.
66. CARB. *Refrigerant Best Management Practices.* Web. 6/5/15.
67. Institute of Refrigeration UK. *Real Zero – Reducing refrigerant emissions & leakage – feedback from the IOR Project.* 2010. Web. 6/5/15.
68. ACR Today. *Kevin Priest from A1-CBISS explores ins and outs of gas leak detection.* 19 May 2014. Web. 6/5/15.
69. EPA. *GreenChill Partnership.* 6/5/15. Web. 6/5/15.
70. Supermarket News. *Greenchill Retailers Defy Refrigerant Leak Trends.* 9/17/12. Web. 6/5/15.
71. Supra 66.
72. DuPont. *Suva Refrigerants: Leak detector guidance for DuPont Suva refrigerants*. Web. 6/5/15.
73. Real Zero. *Guide to Good Leak Testing.* Web.
74. Emerson Climate Technologies. *Refrigerant Leak Detection System.* Web. 6/5/15.
75. Johnson Controls. *Johnson Controls - RLD-H10PM-1 - Refrigerant Leak Detector, 12VDC.* Web. 6/5/15.
76. Bacharach. *Leak Detection.* Web. 26 Aug 2014.
77. Thermal Gas Systems Inc. *Thermal Gas Systems Refrigerant Leak Detection and Monitoring Systems*. Web. 6/5/15.
78. EOS Climate. *Refrigerant Asset System (RAS) for End Users.* Web. 6/5/15.
79. EPA GreenChill. *Greenchill Store Certification Criteria.* Web. 6/5/15.
80. Real Zero. *Illustrated Guide to 13 Common Leaks.* 2009. Web. 6/5/15.
81. Diversified Pure Chem. *Refrigerant Reclamation.* 2015. Web. 6/5/15.
82. EOS Climate. *Recycling HFC Refrigerants Delivers Immediate, Cost-Effective Climate Protection.* 2015. Web. 6/5/15.
83. EPA. *Section 608 of the Clean Air Act: Stationary Refrigeration and Air Conditioning.* Web. 6/5/15.
84. Supra 78.
85. Linde Gas. *Refrigerant Reclaim Solutions.* Web. 6/5/15.
86. Supra 81.
87. EPA. *EPA-Certified Refrigerant Reclaimers.* 4/10/15. Web. 6/5/15.

Annex 1: Executive Orders and Executive Actions

Annex 1 is a non-exhaustive list of executive orders and actions that have been taken which relate to HFC-free procurement and enacting best refrigerant management practices. Some of these orders mention HFC-free procurement, while others can be interpreted to include HFC-free procurement and enactment of best refrigerant management practices.

- **Executive Order 13101 – Greening the Government through Waste Prevention, Recycling, and Federal Acquisition**,[88] requires the government to purchase environmentally preferable products that have a lesser or reduced effect on human health and the environment when compared to competing products or services that serve the same purpose, and wherever possible, items containing recovered (recycled) materials. The U.S. EPA, as the lead agency in this effort, provides information to assist in accomplishing this requirement.[89] Reclaimed refrigerants as discussed above, could fall under the purview of this order.

- **Executive Order 13423 – Strengthening Federal Environmental, Energy, and Transportation Management,**[90] mandates the acquisition of green products, and establishes criteria for procurement including energy efficiency and reductions in greenhouse gases. HFC-free procurement meets the mandates outlined in this order.

- **Executive Order 13514 – Federal Leadership in Environmental, Energy, and Economic Performance**,[91] orders Federal agencies to use sustainable practices when buying products and services by requiring strategic sustainability high performance plans for each Federal agency and requiring vendors and contractors to meet emissions standards. Planning for HFC-free procurement fits well with strategic sustainability planning and mitigating HFC emissions could help vendors and contractors meet emission standards.

- **Executive Order 13693 – Planning for Federal Sustainability in the Next Decade,**[92] comprehensively outlines mandated steps for agencies to meet policy, GHG reductions, and energy efficiency goals. The Order outlines that federal agencies are leaders to building a clean energy economy, and that acquisition management will continue to drive GHG reductions and support the preparations of climate change. The Order outlines that federal agencies have the opportunity to reduce direct GHG emissions by at least 40 percent over the next decade, while at the same time fostering innovation, reducing spending, and strengthening the communities in which federal facilities operate. As outlined in this document, energy efficient, climate-friendly, HFC-free products will greatly complement this order on all levels.

- **Executive Action: Promote the Use of Safer Alternatives to HFCs in the Federal government**[93]

  Updating regulations for service and vendor contractors: "The President has already directed federal agencies to purchase safer and cleaner alternatives to HFCs whenever feasible and to transition to equipment that uses safer and more sustainable alternatives. Federal purchasers can enhance efforts to achieve this goal by procuring climate-friendly HFC alternatives, primarily in refrigeration, air conditioning equipment, and foam insulation in federal buildings. At the announcement of this Action, the Administration began the formal process of reviewing revisions to federal acquisition regulations to promote the use of safer chemical alternatives to HFCs by service and vendor contractors. To help agencies monitor progress, contractors will be asked to keep track of and report on the amounts of HFCs added or removed during routine maintenance, repair or disposal of any government equipment, appliances or supplies."

Evaluating sustainable technologies in Federal buildings: "As part of its Green Proving Ground (GPG) program, the U.S. General Services Administration is inviting technology manufacturers and industry stakeholders, including those that offer HFC alternatives, to submit information on innovative and transformational building technologies that can be used in federal buildings. Technologies selected by the program, which conducts real-world evaluations of the performance of emerging building technologies to recommend deployment strategies towards achieving ambitious sustainability goals, will be matched with federally-owned buildings to pilot measurement and verification by objective third-party evaluators. Results from these evaluations will inform public- and private-sector investment decisions, and will help accelerate commercialization and adoption within the Federal government and the real estate industry."

- **Executive Action: Invest in New Technologies to Support Safer Alternatives to HFCs**[94]

  Funding Opportunities for HFC Alternatives: "Today, the Department of Energy is announcing new funding for the research and development of technologies and approaches that lead to energy reductions in U.S. buildings. The funding will encourage next generation, efficient cooling technologies, including examining HVAC (heating, ventilation, and air conditioning) technologies that use alternative refrigerants and those that move beyond using refrigerants altogether. These technologies also have the potential to improve the efficiencies of other building equipment that rely on heat-pumping technologies (e.g., water heaters, refrigerators), in addition to HVAC equipment. The funding will accelerate the development of near-term technologies that have the potential to save significant amounts of energy while also accelerating the development of the next generation of technologies that have potential of "leapfrogging" existing technologies by pursuing entirely new approaches."

- **Executive Action: Encourage Private Sector Investment in Low-Emissions Technology**[95]

  Driving the Market Towards Innovative Climate-Friendly HFC Alternatives: "EPA will continue to expand the list of climate-friendly alternatives to both ozone depleting substances and high-GWP HFCs, and is currently working on its next listing notice under the Significant New Alternatives Policy (SNAP) program, including both non-fluorinated and fluorinated alternatives that can be used in important sectors."

  Organizing Sector Workshops: "EPA and the Alliance for Responsible Atmospheric Policy will work with other interested governments, international agencies, private sector organizations and civil society to organize a series of sector-specific workshops. These workshops will provide an opportunity to share information on technologies, policies, and standards, will address the technical aspects of transition, including barriers that slow the uptake of alternatives, and will also include information on policy initiatives."

  Engaging Stakeholders on Refrigerant Management Regulations: EPA received a petition from the Alliance for Responsible Atmospheric Policy to create consistent refrigerant management regulations by applying the same rules that already exist for ozone depleting refrigerants to HFCs. EPA recognizes that refrigerant management is an important way to reduce climate-damaging emissions from equipment used for air conditioning and refrigeration, and will engage with stakeholders as it explores options for addressing the petition."

Annex 2: Agency Programs and Initiatives

Annex 2 is a non-exhaustive list of existing agency programs and initiatives that can be utilized to encourage and promote HFC-free procurement and best refrigerant management practices. These programs currently provide a foundation for procurement of environmentally-friendly, energy efficient products and can be a critical tool in procuring energy efficient HFC-free technologies. The programs listed below can be adjusted to promote and encourage procurement of HFC-free technologies, where feasible, and provide tools for best refrigerant management practices.

General Services Administration (GSA) Programs

- **Green Procurement Compilation (GPC)**[96]

  The GPC is a comprehensive green purchasing resource designed for federal contracting personnel and program managers. It consolidates and organizes information from federal environmental programs in one place. HFC-free products can be highlighted and encouraged in the GPC.

- **Sustainable Facilities Tool (SFTool)**[97]

  The SFTool can help in taking action to green buildings, purchases, and operations. HFC-free product procurement can play a critical role in the sustainability of facilities. The SFTool can act to highlight the importance to sustainable facilities of HFC-free procurement and mitigating emissions of HFCs through providing tools for procurement and best refrigerant management practices.

- **Green Proving Grounds Program (GPG)**[98]

  GSA's GPG program represents an innovative response to Executive Order 13514. To meet target sustainability goals and enable the realization of net-zero buildings, federal agencies must develop effective ways of reducing energy use. GPG leverages GSA's real estate portfolio to evaluate innovative sustainable building technologies and provide recommendations on their deployment. By devoting research to technologies in the pre- or early-commercial stages of development, GPG facilitates and accelerates the transition between bench-scale technology and commercial viability. GPG works with the Department of Energy's National Laboratories to evaluate technologies. GPG can work to encourage the laboratories to increase development of HFC-free technologies and prioritize proving new HFC-free technologies in order to allow for wider procurement by the Federal government.

Department of Energy (DOE) Programs

- **National Laboratories and Technology Centers**[99]

  The DOE's National Labs work to address large scale, complex research, and development challenges with a multidisciplinary approach that places an emphasis on translating basic science to innovation. Several of the laboratories, such as the Oak Ridge National Laboratory, are working to accelerate and advance emerging technologies in refrigeration and air conditioning. These laboratories can be a critical tool in accelerating the development of HFC-free low-GWP technologies and should prioritize HFC-free technological development.

- **Office of Energy Efficiency and Renewable Energy (EERE)**[100]

  The Office of EERE accelerates development and facilitates deployment of energy efficiency and renewable energy technologies and market-based solutions that strengthen U.S. energy security,

environmental quality, and economic vitality. The Building Technologies Office of the EERE has an Emerging Technologies Program[101], which works to develop technologies that reduce building energy use. The Emerging Technologies program can be a crucial tool in developing energy efficient HFC-free technologies.

- **Federal Energy Management Program (FEMP)**[102]

  The DOE's Federal Energy Management Program (FEMP) works with key individuals to accomplish energy change within organizations by bringing expertise from all levels of project and policy implementation to enable Federal agencies to meet energy-related goals and provide energy leadership to the country. There is opportunity for FEMP to work with companies manufacturing energy efficient HFC-free technologies and utilize those products to achieve energy-related goals.

- **Energy Savings Performance Contracts Under FEMP**[103]

  Energy savings performance contracts (ESPCs) allow federal agencies to complete energy-savings projects without up-front capital costs and special Congressional appropriations. An ESPC is a partnership between a federal agency and an energy service company (ESCO). The ESCO conducts a comprehensive energy audit of federal facilities and identifies improvements to save energy. In consultation with the Federal agency, the ESCO designs and constructs a project that meets the agency's needs and arranges the necessary funding. The ESCO guarantees that the improvements will generate energy cost savings to pay for the project over the term of the contract (up to 25 years). After the contract ends, all additional cost savings accrue to the agency. ESPCs can be utilized to incorporate energy efficient HFC-free technologies in federal facilities.

Department of Defense (DOD) Policies and Programs

- **DOD's Green Procurement Program (GPP)**[104]

  The DOD's GPP requires green products and services to be purchased to the maximum extent practicable, consistent with the requirements of relevant Federal Green Purchasing Programs and DOD Green Procurement Metrics. The Federal Green Purchasing Program requires products to have attributes that include energy efficiency, low embodied energy, and reduced environmental impact over the lifecycle, and reduced or eliminated toxic substances. The GPP can include language that mandates HFC-free procurement where available.

- **Better Buying Power (BBP)**[105]

  The BBP is the implementation of best practices to strengthen the Defense Department's buying power, improve industry productivity, and provide an affordable, value-added military capability to the Warfighter. Launched in 2010, BBP encompasses a set of fundamental acquisition principles to achieve greater efficiencies through affordability, cost control, elimination of unproductive processes and bureaucracy, and promotion of competition. BBP initiatives also incentivize productivity and innovation in industry and government, and improve tradecraft in the acquisition of services. HFC-free natural and not-in-kind technologies meet and exceed these directives.

  - *Better Buying Power Memo for Acquisition Professionals by Ashton Carter*[106]

    Directs the Department to incentivize productivity and innovation in industry and emphasized the need for greater performance in

procurement. Directed an improvement in both the overall rate of competition and the rate of effective competition.

- **Sustainable Product Purchasing Program**[107]

  The DOD established a sustainable product purchasing program to enhance and sustain mission readiness through cost effective acquisition that achieves compliance and reduces resource consumption and solid and hazardous waste generation. Sustainable product purchasing efforts span from transportation and energy to recycled and bio-based content. Comprehensive information on DOD's Sustainable Product Purchasing can be found on the GSA's Sustainable Facilities Tool website. Mitigating HFC emissions by procuring HFC-free products will help with sustainability efforts of the DOD.

Environmental Protection Agency (EPA) Policies and Programs

- **Environmentally Preferable Purchasing (EPP)**[108]

  EPA's Environmentally Preferable Purchasing (EPP) Program is helping agencies across the Federal government comply with green purchasing requirements, and, in doing so is using the Federal government's enormous buying power to stimulate market demand for green products and services.

  Federal agencies are directed by federal laws, regulations and executive orders to make purchasing decisions with the environment in mind. The EPA created the EPP program in 1993 to help federal officials meet these requirements. Most recently, these requirements have included Executive Order 13514 (see above), which orders federal agencies to use sustainable practices when buying products and services. Procurement of HFC-free products should be encouraged and promoted, where feasible, in the EPP program.

MOU: Federal Leadership in High Performance and Sustainable Buildings

- With this Memorandum of Understanding, signatory agencies commit to federal leadership in the design, construction, and operation of high performance and sustainable buildings.[109] A major element of this strategy is the implementation of common strategies for planning, acquiring, siting, designing, building, operating, and maintaining High Performance and Sustainable Buildings. The signatory agencies will also coordinate with complementary efforts in the private and public sectors. HFC-free products meet high performance and sustainability standards and should be incorporated in design, construction, and operation of high performance and sustainable buildings.

Annex 3: HFC-free Equipment and Products Listed by SNAP Sector

Annex 3 is a list of HFC-free equipment and products that are currently available on the market. These products are achieving higher efficiency than HFC-based systems and have much lower climate impacts. The company name is also a link to the company site or the site that is specific to the particular product. This is not an exhaustive list and there are new HFC-free products and technologies coming on the market on a frequent basis, additional research is encouraged.

Refrigeration and Air Conditioning

Company	Product(s)	Product Details	SNAP End Use
Carnot Refrigeration	Commercial and Industrial Refrigeration Systems	Transcritical CO_2 refrigeration systems and ammonia/CO_2 cascade systems.	Retail Food Refrigeration and Industrial Refrigeration
Hillphoenix	Commercial Refrigeration Systems	CO_2 transcritical booster supermarket refrigeration system as an alternative to traditional direct expansion systems. Hillphoenix also offers merchandiser units and display cases.	Retail Food Refrigeration
Emerson Climate Technologies	Commercial Refrigeration and HVAC	Wide range of solutions using natural refrigerants CO_2 and ammonia.	Retail Food Refrigeration, Residential and light commercial air conditioning
Hussmann	Commercial Refrigeration Systems	Micro-distributed propane systems as alternative to traditional direct expansion supermarket refrigeration system.	Retail Food Refrigeration
Systemes LMP	Commercial Refrigeration Systems	Transcritical and ammonia/CO_2 cascade systems.	Retail Food Refrigeration
AHT USA	Refrigerated Display Cases, Cabinets and Island Merchandisers	Display cases, cabinets, and island merchandisers using low-GWP hydrocarbons.	Retail Food Refrigeration
True Manufacturing	Refrigerated Display Cases, Commercial Refrigerators, Vending Machines	Glass and solid door commercial refrigerators, supermarket cabinets, and other products for food and beverage refrigeration that use propane as the refrigerant and HFC-free Ecomate foam insulation. 15% energy efficiency improvement over HFC models.	Retail Food Refrigeration
Unilever	Commercial Freezers	Unilever manufactures ice cream freezers for Ben & Jerry's. Energy consumption reduced by 70% compared to conventional HFC models.	Retail Food Refrigeration
Azane	Industrial Refrigeration and Chillers	Low-charge ammonia refrigeration and chiller units. Achieving 20% greater efficiency than HFC/HCFC-based systems.	Industrial Refrigeration
Cimco	Industrial Refrigeration and Chillers	Ammonia and CO_2 based industrial refrigeration and chillers.	Industrial Refrigeration
Evapco	Industrial Refrigeration and Chillers	Ammonia and CO_2 based units achieving high efficiency.	Industrial Refrigeration
GEA Refrigeration	Industrial Refrigeration, Chillers, and Heat Pumps	Industrial refrigeration, chillers, and heat pumps using ammonia and CO_2 as refrigerants.	Industrial Refrigeration

Company	Product(s)	Product Details	SNAP End Use
Mayekawa	Ultra-low temperature system	The pascal air systems relies solely on air and achieves temperatures as low as -100°C, while reducing power usage by 40%.	Industrial Refrigeration
Thermo Scientific	Ultra-low Temperature System	Ultra-low temperature unit that relies on natural refrigerants and achieves higher efficiency compared to a conventional HFC unit.	Industrial Refrigeration
SandenVendo America	Vending Machines	Vending machines using CO_2 refrigerant and achieving higher efficiency than HFC based 134a systems.	Vending Machines
Coca-Cola	Vending Machines	CO_2 vending machines with HFC-free foam insulation that yield 50% energy efficiency improvements.	Vending Machines
PepsiCo	Vending Machines	Propane vending machines with HFC-free foam insulation that yield 60% reduction in energy consumption.	Vending Machines
Avanti	Mini-refrigerators	Avanti isobutane mini-refrigerator units for light refrigeration in office settings.	Household refrigerators and freezers
Bosch U.S.A	Residential Refrigerators	Hydrocarbon refrigerators that deliver up to 40% gains in energy efficiency.	Household refrigerators and freezers
Blupura USA	Water coolers	Various models of propane and isobutane water coolers suitable for cafeterias, schools, and office spaces with up to 75% reductions in energy consumption.	Water coolers
General Electric	Residential Refrigerators	Refrigerators using isobutane as the refrigerant and HFC-free cyclopentane foam for insulation.	Household refrigerators and freezers
Source Refrigeration & HVAC	Commercial Refrigeration and HVAC	Specializes in CO_2 ammonia and propane systems.	Retail Food Refrigeration, Residential and light commercial air conditioning
Mayekawa USA Inc.	Adsorption Chillers	AdRef-Noa adsorption chillers using Zeolite and water as a refrigerant to produce chilled water. Use of waste heat for as energy source leads to impressive energy efficiency.	Chillers
Power Partners	Adsorption Chillers	ECO-MAX adsorption chillers ranging from 30 to 250 tonnes using water as a refrigerant. Utilizing waste heat as energy source leads to impressive energy efficiency.	Chillers
Coolerado	Evaporative Air Conditioners	Standalone units in various models/capacities for industrial, commercial and residential cooling, that provide energy efficiency improvement of up to 90 percent.	Residential and light commercial air conditioning and heat pumps
Munters	Dehumidifiers	A range of stand-alone desiccant dehumidifiers for various sized applications ranging from commercial to industrial units. Configurations that replace the reactivation compressor with hot water from a waste heat source to further enhance energy savings and completely eliminate HFC usage in the unit.	Residential dehumidifiers
Mayekawa	Heat Pump	Mayekawa manufactures air-to-water and water-to-water heat pump systems. The transcritical CO_2 Unimo Air to Water heat pump has a heating capacity of up to 110 kW.	Residential and light commercial air conditioning and heat pumps

Company	Product(s)	Product Details	SNAP End Use
Sanden	Heat Pump	CO_2 based heat pump water heater.	Residential and light commercial air conditioning and heat pumps
Multistack	Heat Pump	CO_2 based transcritical heat pump hot water heater.	Residential and light commercial air conditioning and heat pumps
Hoshizaki	Ice Machines	Ice machines using propane as a refrigerant	Commercial ice machines
Manitowoc	Ice Machines	50 Hz ice machines using propane including its models QP-210, QP-270, IP-320, and IP-500.	Commercial ice machines

Foam Blowing Agents

SNAP End-Use	Company	Product Details
Rigid Polyurethane: Spray, Commercial Refrigeration, and Sandwich Panels	BASF	Enertite: Open-cell water-blown spray foam.
	Biofoam Spray Foam Insulation	Biofoam 800: Open-cell water-blown, semi-rigid spray foam.
		Biofoam 1600: Closed-cell water-blown spray foam.
		Biofoam 2700: Closed-cell water-blown rigid spray foam used in heavy duty applications.
	Cannon USA	A-Penta/A-Penta Twin: Spray foam machines designed for use with hydrocarbon blowing agents (cyclopentane, n-pentane)
	Demilec	Sealection 500: Open-cell water-blown spray foam.
	Ecomate	Methyl formate blown spray foam and panels.
	Gaco Western	GacoFireStop2: Open-cell water-blown spray foam rated for class 1 fires.
		GacoProFill: Open-cell water-blown spray foam used in empty cavities in residential and commercial construction.
		Gaco 052N: Open-cell water-blown, semi-rigid low-density foam.
		GacoToughFoam: Closed-cell water-blown high-density spray foam.
	Icynene	ProSeal Eco: Closed-cell water-blown medium density spray foam providing structural and vapor retardance properties.
		Classic Plus: Open-cell water-blown low density spray foam.
	LaPolla	AirTight OC: Open-cell water-blown spray foam.
Rigid Polyurethane: Slabstock and Other	Cannon USA	CarDio Process: Liquid CO2 blown slabstock.
		Vacuum Assisted Foam Injection panels.
	Hennecke	Manufacturing of slabstock machines and systems for production lines.
	Polyurethane Process Industries	ECOPlus and ECOMASTER: High pressure metering machines using pentane as a blowing agent.
Rigid Polyurethane & Polyisocyanurate	Cannon USA	CDL Laminators for continuous and discontinuous foam insulated panels.
	Dyplast	ISO-C1: Polyisocyanurate insulated panels blown with hydrocarbons.

Laminated Boardstock	**Polyiso**	Closed-cell rigid foam board using hydrocarbon blowing agents.
Flexible Polyurethane: Furniture, Bedding, Chair Cushions, and Shoe Soles	**Cannon USA**	Automotive seating using CO2 as a blowing agent.
	Ecomate	Open-cell flexible foam using methyl formate as a blowing agent.
	Hennecke	Carbomat: Metering unit for CO2 blown flexible foam applications.
	Zotefoams	Nitrogen blown closed-cell foam for shoes, sports and leisure (backpacks, camping mats), artifact conservation and personal protection (helmets).
Integral Skin Polyurethane: Car Steering Wheels, Dashboards and Shoe Soles	**Ecomate**	Integral skin applications using methyl formate as a blowing agent.
	Zotefoams	Nitrogen blown closed-cell foam for damping, sealing and insulating materials in the automotive and aviation industry.
Polystyrene: Extruded Sheet	**Dyplast**	Hydrocarbon blown insulating panels. Used at a USPS in Philadelphia.
	Ecomate	Ecomate can be co-blown to cut use of HFCs or can be blown with a low-GWP blowing agent.
Polystyrene: Extruded Boardstock & Billet	**Zotefoams**	Closed-cell nitrogen blown foam for marine buoyancy.
Polyolefin: Foam Sheets and Tubes	**Zotefoams**	Closed-cell nitrogen blown polyolefin foam.
Phenolic Insulation Board & Bunstock	**Dyplast**	Hydrocarbon blown insulating board.
	ITW Insulation Systems	TRYMER Supercel: Closed-cell rigid phenolic foam blown with hydrocarbon blowing agents.

Fire Suppression

Company	Product	Product Details	SNAP End-Use
AFEX	Fire Suppression System	Dry chemical, wet agent and dual agent systems for use on mobile heavy equipment.	Total Flooding
Amerex	ABC Multi-Purpose Stored Pressure Dry Chemical Extinguishers	Class A, B, or C fires	Streaming
	Class D Stored Pressure Dry Powder	Class D	Streaming
	CO2 Models 320 NM, 322 NM	Class B	Streaming
	Foam Stored Pressure Extinguishers	Class A and Class B	Streaming
	Industrial Systems	Class A, B, or C fires	Total Flooding
	Model 240 Water Extinguisher	Class A	Streaming
	Water Mist - MRI Compatible	Class A and C	Streaming
	Wet Chemical Stored Pressure Class "K" Kitchen	Class A and K commercial kitchen fires	Streaming
Ansul	High and Low Pressure Carbon Dioxide System	Class A, B, or C	Total Flooding
	Aquasonic System	Suppression of Class B combustibles	Total Flooding
	Dry Chemical Piped	Industrial facilities	Total Flooding
	Sentry Water Extinguishers	Class A Hazards	Streaming
	Red Line Wheeled and Cartridge-Operated Hand Portable Units - Dry Chemical	Large scale fire and high fire risk areas. Industrial applications, such as airports, offshore platforms, and fuel storage	Streaming
Badger	Advantage Dry Chemical - Line of Extinguishers for Commercial Purposes	Class A, B, or C fires (Commercial)	Streaming
	MRI Non-Magnetic B5V CO2	Class B and C fires in MRI rooms	Streaming
Fike	CO2 Fire Suppression System	Class A, B, C	Total Flooding
Fire Trace	Engineered Clean Agent Systems for Larger Environments	Special hazards	Total Flooding
Kidde Fire Systems	High Pressure CO2 Systems	Ideal for industrial processes.	Total Flooding
	IND Dry Chemical System	Class A, B, or C fires	Total Flooding
	Commercial Kitchen Wet Chemical System	Commercial Kitchen Fires	Total Flooding
	Marine Suppression Systems	Marine Class A, B, C	Total Flooding & Streaming
Vanguard Fire & Security Systems, Inc.	Sapphire Clean Agent Systems	Class A, B, or C fires	Total Flooding
	Inergen	Data Centers	Total Flooding
	Wet Sprinkler System	Warehouses, factories, hospitals, stores, residential buildings	Total Flooding
	Pre-Action Sprinkler Systems	Flammable liquid handling, storage areas for valuable artifacts, libraries, archives and more	Total Flooding
	Deluge Sprinkler Systems	Flammable liquid handling, storage areas for valuable artifacts, libraries, archives and more	Total Flooding

Aerosols and Solvents

Company	Product	Product Details	SNAP End Use
Canless Air	Air Duster	The O2 Hurricane Canless Air Duster System is HFC-free and rechargeable and can be used many times over. The system has no inhalation, frostbite health hazards, danger of explosion or flash fires.	Propellant
5 Star	Air Duster	5 Star HFC-free air duster uses propane as its propellant. The duster can be used on printers, keyboards, and general office equipment.	Propellant
Office Depot/Staples	Air duster	HFC-free air dusters for cleaning computer keyboards and other electronics.	Propellant
Trinity	Tire Inflator	The Trinity Portable Tire inflator uses a 20oz pressurized CO2 tank that can be used to fill car tires, truck tires, lawn mower, and bike tires	Propellant
Defense Technology	Defense Pepper Spray	This safety spray marketed for use by law enforcement is a 3oz flip canister that provides between 20-25 one second bursts and uses nitrogen as the propellant	Propellant
Azer Scientific	Medical Freeze Spray	A 10oz aerosol can to be used for freezing tissue samples	Propellant
Shell	Isoparaffins, pentanes, aromatics, and aliphatics	Shell produces a wide range of HFC-free hydrocarbon-based solvents.	Solvent
Safety-Kleen	Solvents	Produces a variety of low-GWP cleaning solvents for several uses.	Solvent
Enviro Tech International, Inc.	Solvents	Produces several kinds of low-GWP industrial cleaning solvents.	Solvent

Annex References

88. Federal Register. *Executive Order 13101.* Web. 6/5/15.
89. EPA. *Greening Government Procurement.* 6/14/13. Web. 6/5/15.
90. Federal Register. *Executive Order 13423.* 1/26/07. Web. 6/5/15.
91. The White House. *Executive Order Federal Leadership in Environmental, Energy, and Economic Performance.* 10/5/09. Web. 6/5/15.
92. The White House. *Executive Order 13693.* 3/19/15. Web. 6/5/15.
93. Supra 31.
94. Supra 31.
95. Supra 31.
96. GSA. *Green Procurement Compilation.* 4/27/15. Web. 6/5/15.
97. GSA. *Sustainable Facilities Tool.* Web. 6/5/15.
98. GSA. *Green Proving Ground.* Web. 6/5/15; GSA. *What is GPG?* 5/28/15. Web. 6/5/15.
99. DOE. *About the National Labs.* Web. 6/5/15.
100. DOE EERE. *Office of Energy Efficiency and Renewable Energy: About Us.* Web. 6/5/15.
101. DOE EERE. *Emerging Technologies.* Web. 6/5/15.
102. DOE EERE. *Federal Energy Management Program.* Web. 6/5/15.
103. DOE EERE. *Energy Savings Performance Contracts.* Web. 6/5/15.
104. DOD. *Department of Defense Green Procurement Program Strategy.* 11/1/08. Web. 6/5/15.
105. DOD. *Better Buying Power.* Web. 6/5/15.
106. DOD. *Better Buying Power Initiative.* Web. 6/5/15.
107. DOD. *DOD Sustainable Product Purchasing*. Web. 6/5/15.
108. EPA. *Environmentally Preferable Purchasing (EPP).* Web. 6/5/15.
109. EPA. *MOU: Federal Leadership in High Performance and Sustainable Buildings.* Web. 6/5/15.

This page intentionally left blank



Environmental Investigation Agency

PO Box 53343
Washington, DC 20009 USA
Tel: +1 202 483-6621 Fax: +1 202 986-8626
Email: info@eia-global.org