

May 2009

## REPORT OF THE HFC EMISSIONS ESTIMATING PROGRAM

### 2002 - 2007 DATA COLLECTION

#### Introduction

Hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) have been commercialized as replacements for ozone-depleting substances such as chlorofluorocarbons (CFCs) and halons. The development of these chemicals for use in fire and explosion suppression applications has been instrumental in achieving the accelerated halon production phaseout mandated by the Montreal Protocol on Substances that Deplete the Ozone Layer. At the same time, the use of these classes of chemicals carries with it some environmental concern and, therefore, the need to minimize emissions.

While HFCs and PFCs are not ozone-depleting substances, they have been identified by the Intergovernmental Panel on Climate Change as potent greenhouse gases with long atmospheric lifetimes and are part of the basket of six gases included in the Kyoto Protocol to the United Nations Framework Convention on Climate Change. Emissions of SF<sub>6</sub>, HFCs and PFCs currently represent less than 3% of total greenhouse gas emissions. Emissions of HFCs and PFCs from fire protection are estimated at less than 1% of total HFC and PFC emissions from all sources. Nevertheless, because of their significant atmospheric impacts once released, careful management of these gases is an essential component of U.S. climate protection and stratospheric ozone goals.

#### Fire Protection and Environmental Protection

The U.S. fire protection industry fully supports the goal of minimizing non-fire emissions of fire protection agents, and is committed to continuing to contribute to both ozone layer and climate change protection. The overriding concern of the fire protection industry, however, is the reduction of risk to people and property from the threat of fire through the use of products and systems proven to be effective. With the aim of ensuring that both of these goals are achieved, the fire protection industry has developed a voluntary code of practice that is intended to focus the industry's efforts on minimizing emissions of HFC and PFC fire protection agents.

The Voluntary Code of Practice for the Reduction of Emissions of HFC & PFC Fire Protection Agents (VCOP) is a partnership of the U.S. Environmental Protection Agency (EPA), Fire Equipment Manufacturers Association (FEMA), Fire Suppression Systems Association (FSSA), Halon Alternatives Research Corporation (HARC) and National Association of Fire Equipment Distributors (NAFED). Since its was launched in March 2003, this program includes twenty-two partner companies, representing fire equipment manufacturers and distributors throughout the U.S. that are working to meet the goals of the VCOP through training, education, and reporting on HFC and PFC uses. This innovative partnership serves as an important model for national and international voluntary industry efforts in other sectors, such as mobile air-conditioning and refrigeration, committed to achieving responsible use of HFC and PFC alternatives for ozone-depleting substances.

## **HFC Emissions Estimating Program (HEEP)**

Accurate, credible recordkeeping and reporting is central to meeting the goals of the Voluntary Code of Practice (VCOP). Successful implementation of the elements of the VCOP must necessarily rely on a verifiable baseline of HFC emissions. The HFC Emissions Estimating Program (HEEP) provides a format to help industry minimize emissions by setting benchmarks, by providing the incentives to make improvements to current standards and practices, by documenting the industry's commitment to safety and responsible use, and by providing data to support these substitutes for halon systems. The essential elements of the HEEP are as follows:

- Collection and submission of data from reporting parties in industry that are in a position to make relevant measurements.
- Not all fire equipment companies need to be reporting parties in order for data collection to be substantially complete. Only the following need be reporting parties:
  - Equipment manufacturers or distributors that perform 1<sup>st</sup> Fill of original equipment and also recharge equipment.
  - Agent suppliers or equipment manufacturers that sell to distributors that only perform recharge.
- "Emission" for the purposes of the HEEP is defined as the quantity of agent sold for the purpose of "recharge" of fire suppression containers. This approach is deemed reasonable as recharge is only required after agent has been discharged or emitted from equipment.
- Distributors who recharge cylinders but do not fill original equipment – most distributors – do not need to report as their agent use would be reported by their supplier.
- An independent 3<sup>rd</sup> Party will collect industry reports of emissions by agent type, convert the values to equivalent emissions of carbon dioxide, and report only aggregate results annually back to industry.

## **Data Collection Effort**

In August 2002 a survey was distributed to a list of companies previously identified as possible reporting parties and to the members of FEMA, FSSA, HARC, and NAFED. The purpose of the survey was to identify all of the companies in the U.S. that were likely to be HEEP reporting parties based on the criteria outlined above. By distributing the survey to the members of the four major fire protection associations, it was felt that all of the appropriate companies would be reached. Based on the response to the survey and additional input from industry experts, a final list of 23 reporting parties was identified.

In March 2003, June 2004, January 2006, and February 2008 guidance letters and data collection forms were sent to the 23 reporting parties asking for pounds of HFC/PFC fire protection agents sold for recharge in 2002, 2003, 2004, 2005, 2006, and 2007 respectively. A list of the agents for which data was requested along with the global warming potentials (GWPs) used to calculate carbon dioxide (CO<sub>2</sub>) equivalence for each agent are shown below.

HFC / PFC Chemical ASHRAE Designation	Global Warming Potential (GWP)
HFC 23	11,700
PFC 14	6,500
HFC 125	2,800
HFC 134a	1,300
HFC 227ea	2,900
HFC 236fa	6,300
PFC 3-1-10	7,000

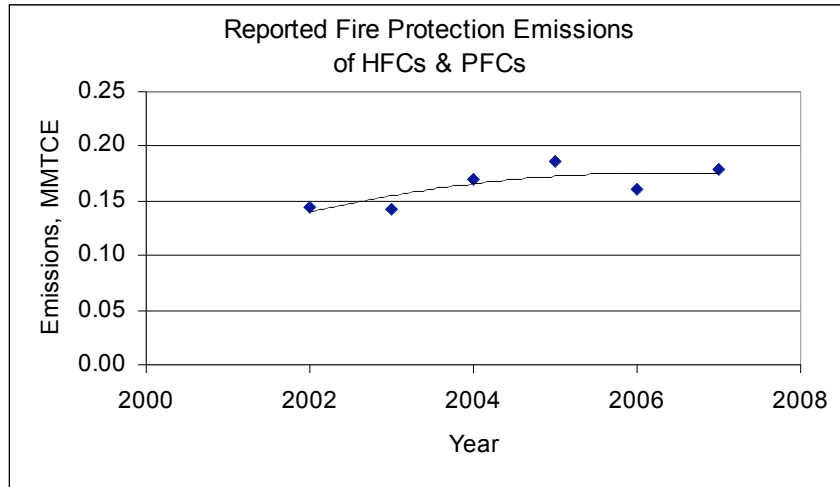
## Results

Data were submitted by 20-22 reporting parties for the years 2002 to 2007. In each year emissions data were reported for the agents HFC-23, HFC-125, HFC-236fa, HFC-227ea, and PFC 3-1-10. The total of the reported emissions for each agent was multiplied by its respective GWP to obtain an equivalent of carbon dioxide. The reported emission amounts of all five agents were then added to obtain a total reported emission for each year, expressed in millions of metric tons of carbon dioxide, or MMTCO<sub>2</sub>. This number can be multiplied by 12/44<sup>1</sup> to obtain the emission amount in terms of carbon alone expressed as million metric tons of carbon equivalent, or MMTCE.

The combined results reported to date are given in the table and illustrated graphically below.

Year	Companies Reporting	MMTCO <sub>2</sub>	MMTCE
2002	22	0.530	0.145
2003	20	0.523	0.143
2004	21	0.625	0.170
2005	21	0.681	0.186
2006	21	0.591	0.161
2007	21	0.655	0.179

<sup>1</sup> Carbon dioxide consists of 12 parts carbon and 32 parts oxygen on a mass basis. Thus, 12/44 is the mass fraction of carbon dioxide that is elemental carbon.



In order to put these numbers in perspective, they can be compared to estimates of emissions from other applications and to estimates of emissions of HFC/PFC fire protection agents based on modeling. The EPA vintaging model is a source for estimating emissions of greenhouse gases used as substitutes for ozone depleting substances. It tracks chemical consumption and emissions by making detailed calculations in over 40 end-uses of the quantity of equipment or products sold, serviced, and retired each year, what chemical(s) are being used, and the amount of chemical required to manufacture and/or maintain the equipment.

Estimates of emissions of HFCs/PFCs for fire protection from the EPA vintaging model are 0.18 MMTCE in 2005, 0.21 MMTCE in 2006, and 0.23 MMTCE in 2007. EPA estimates of 2007 emissions for other applications are as follows: 26.59 MMTCE from refrigeration and air conditioning, 1.70 MMTCE from aerosols, and 0.71 MMTCE from foams.

## Discussion

Without adjusting for the small differences in the number of reporting companies, the data show an increase in emissions of about 24% from 2002 to 2007, or an average increase of about 4% per year. The data for 2004 to 2007, which can be compared directly because it comes from the same 21 reporting companies, show an increase in emissions of 4.8%. However, a linear regression analysis of the same data indicates no increase in emissions over the four-year period. With the addition of data for 2006 and 2007, the emissions trend line has gone from what appeared to be an increasing trend to a leveling off over the last four years. Considering that the size of the installed base of HFC fire protection systems would be expected to increase every year, a leveling off of emissions may be the result of a decrease in emission rate.

In setting up this program the hope was that over time emissions of HFCs and PFCs from fire protection uses would decrease with the implementation by the industry of the Voluntary Code of Practice (VCOP). Although interpretation of the year-to-year emissions data is difficult due to changes in the installed base and the mix of agents that are sold for fire protection, the HEEP data may now be reflecting a positive impact of the VCOP on emissions of high-GWP gases from fire protection.

### **Conclusions**

- The HFC Emissions Estimating Program (HEEP), which was devised to develop fire industry emissions data, has been successfully launched.
- Successful continuation of HEEP seems likely based on industry responses.
- The six years of emissions data collected thus far are consistent and reflect somewhat lower GHG emissions rates than originally expected.
- The emissions trend line appears to be leveling off, which may reflect a decrease in emission rates.
- Overall, the VCOP and HEEP programs appear to be serving their intended purposes.