



The Climate Registry

Tips for Reporting Refrigerants August 2009

Who should report fugitive emissions from refrigerants?

- Organizations that use and own refrigeration and air conditioning equipment, including household, commercial, industrial, and motor vehicle refrigeration and air conditioning systems

The Climate Registry has prepared this tip sheet to help Members calculate and report fugitive emissions of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) from refrigeration and air conditioning equipment that leak during installation, use, and disposal.

What are HFCs? What are PFCs?

HFCs are manmade substances made up of carbon, hydrogen, and fluorine atoms only. The main use of HFCs is in the manufacture of refrigerators and air conditioners, but HFCs can also be used as a propellant in aerosol cans as an alternative to ozone-depleting substances, which are now being phased out under the Montreal Protocol.

PFCs are also manmade substances and are made up of carbon and fluorine atoms only. PFCs are typically used as industrial solvents but have a broad range of uses including medical applications, aluminum production, manufacture of computer chips and other semiconductors, insulators or coolants of electrical or electronic applications, fire extinguishers, and refrigerants.

What refrigerants have GHGs and where might I find them?

Most entities have HFCs and PFCs in their common refrigeration systems. These may include industrial, commercial, or transport refrigeration systems; as well as fire extinguishing systems. When any of this equipment is installed, operated, serviced or retired there may be leaks of refrigerant, which are unintentional releases of the gas, or fugitive emissions. Table 1 provides a list of required refrigerants to be reported under The Registry's voluntary program. In addition, you may optionally report other GHG refrigerants.

When should I report refrigerant fugitive emissions?

If you own or operate any equipment that utilizes HFCs or PFCs, your inventory should reflect this equipment. You may only have emissions in years where this equipment is serviced, but you should account for your inventory in each year. Even though only small amounts of gases may leak, these may have extremely high Global Warming Potentials (GWP), meaning that even small amounts can contribute significantly to your overall footprint.

Where can I get the information I need to report?

The data necessary to calculate these emissions are available when equipment is serviced and/or containers of HFCs and/or PFCs are purchased, used, or sold. This includes service reports or logs, and purchase or usage records. If you maintain this equipment yourself you may have the records necessary to track emissions.

However, much of this equipment is not serviced each year, meaning there might be no emissions. If you do not maintain this equipment yourself, you may be best suited to estimate these emissions using simplified methods. If equipment is not serviced and its emissions represent a small portion (equal to or less than 5 percent) of the inventory, then you may rely on an upper bounds estimation to determine these fugitive emissions.

Important Note: This document should only be used as a tool to understand how and when to report fugitive emissions. Please refer to GRP Chapter 16 for complete information on creating an inventory of fugitive emissions from refrigerants.

How should I report fugitive emissions?

There are three methods for estimating emissions of HFCs and PFCs from refrigeration and air conditioning equipment (or any other equipment using HFCs or PFCs):

1. **Mass Balance Approach**
2. **Simplified Mass Balance Approach**
3. **Screening Method**, which can be used to determine whether emissions fall below 5 percent of your total entity-wide emissions, and if so, may be used as a simplified estimation method (see GRP v. 1.1 Chapter 11).

What information do I need to report when using these methods?

First, you need to identify whether you own or operate equipment that uses one of the required HFCs or PFCs (see Table 1 in this document or GRP v. 1.1 Appendix B). Then, depending on the amount of data available for each piece of equipment, you will be able to determine which fugitive emissions calculation methodology is most applicable for each piece of equipment.

The *Mass Balance Approach* requires the most amount of information and is intended for equipment manufacturers and for equipment users who service their own equipment. Information needed includes:

- base inventory quantities in storage at the beginning and end of each year;
- purchases and sales of refrigerants; and
- changes in total capacity of the equipment.

The *Simplified Mass Balance Approach* is intended for members that probably don't store HFCs or PFCs onsite but own or operate equipment that they service or have contractors service. Information needed includes:

- quantity of HFCs or PFCs used to charge equipment during installation or service;
- HFCs or PFCs recovered from retiring equipment; and
- the total full charges of new and/or retiring equipment.

The *Screening Method* is intended for members that don't own or operate a significant amount of equipment that use HFCs or PFCs, but may own or operate Heating, Ventilating, and Air-Conditioning (HVAC) units, refrigerators, commercial air conditioning units or appliances, motor vehicles, fire extinguishers, etc. Typically the fugitive emissions from these sources represent less 5 percent of an inventory and thus, you can use simplified methods to conservatively estimate these emissions.

TABLE 1: Required HFCs and PFCs		
Common Name	Formula	GWP
Hydrofluorocarbons (HFCs)		
HFC-23	CHF ₃	11,700
HFC-32	CH ₂ F ₂	650
HFC-41	CH ₃ F	150
HFC-4310mee	C ₅ H ₂ F ₁₀	1,300
HFC-125	C ₂ H ₂ F ₅	2,800
HFC-134	C ₂ H ₂ F ₄	1,000
HFC-134a	C ₂ H ₂ F ₄	1,300
HFC-143	C ₂ H ₃ F ₃	300
HFC-143a	C ₂ H ₃ F ₃	3,800
HFC-152	C ₂ H ₄ F ₂	43
HFC-152a	C ₂ H ₄ F ₂	140
HFC-161	C ₂ H ₅ F	12
HFC-227ea	C ₃ H ₂ F ₇	2,900
HFC-236cb	C ₃ H ₂ F ₆	1,300
HFC-236ea	C ₃ H ₂ F ₆	1,200
HFC-236fa	C ₃ H ₂ F ₆	6,300
HFC-245ca	C ₃ H ₃ F ₅	560
HFC-245fa	C ₃ H ₃ F ₅	950
HFC-365mfc	C ₄ H ₅ F ₅	890
Perfluorocarbons (PFCs)		
Perfluoromethane	CF ₄	6,500
Perfluoroethane	C ₂ F ₆	9,200
Perfluoropropane	C ₃ F ₈	7,000
Perfluorobutane	C ₄ F ₁₀	7,000
Perfluorocyclobutane	c-C ₄ F ₈	8,700
Perfluoropentane	C ₅ F ₁₂	7,500
Perfluorohexane	C ₆ F ₁₄	7,400

If you use the simplified estimation method you should locate the charge capacity for each piece of equipment that uses HFCs or PFCs (this information is typically available from the manufacturer or on the equipment nameplate). If this information is not available, then you

should use the upper bound value of the range given by equipment type in Table 16.3 of the GRP v. 1.1.

Most Members will benefit from using the Screening Method, as you may not have easily accessible information about charge capacities; quantities used during installation, service, or recovery; and/or may not have equipment serviced in a given year.

How do I report emissions for my refrigeration or AC units that use a *blend* of HFCs or PFCs?

Refrigerant blends can contain multiple HFCs or PFCs. Because each of the components of a blend have a different global warming potential (GWP) value (see GRP v. 1.1 Table 16.2), you must identify and separately report each HFC or PFC included in the blend of your equipment.

Example of Simplified Estimation Method for an Office-based Organization

GHG Inc. is a small consulting firm with an office in Phoenix, AZ. To create their inventory, GHG Inc. has determined that they own the following items which use HFCs: five passenger cars, one window air-conditioning unit, and two kitchen refrigerators. GHG Inc. leases an office and therefore is not required to report fugitive emissions from the building's central Heating, Ventilating, and Air Conditioning (HVAC) system. However, to fully estimate their operations emissions, GHG Inc. will also include fugitive emissions from the building's central HVAC (district cooling), as a part of their optional emissions.

GHG Inc. has obtained the following information for each piece of equipment:

Type of Equipment	Number of units	Capacity (kg)	Refrigerant used	GWP
Toyota Corolla 2000	3	0.8	HFC-134a	1,300
Ford Escort 2002	2	1.0	HFC-134a	1,300
Kenmore 75101 Window AC Unit	1	5.0	R-407c	1,526
GE® ENERGY STAR® 17.9 Cu. Ft. Top-Freezer Refrigerator	2	0.1	HFC-152a	140
Building HVAC (Chiller)	1	50	HFC-134a	1,300

GHG Inc. has not had any of the above equipment serviced in the last year, but is fairly confident that these fugitive emissions represent less than 5 percent of their total entity-wide emissions. Given this assumption, GHG Inc. begins with the *screening method* to determine if the *simplified estimation method* is appropriate.

Given the above information, GHG Inc. determines their entity's fugitive emissions using default emission factors from Table 16.3 and Equation 16e by refrigerant type (pages 129 and 130 in GRP v.1.1).

NOTE: no piece of equipment was installed, serviced, or retired during the reporting year.

a) HFC-134a (Vehicles)

$$\text{HFC-134a} = [((0.8 \times 3) \times 20\% \text{ EF} \times 1 \text{ year}) + ((1.0 \times 2) \times 20\% \text{ EF} \times 1 \text{ year})] / 1,000$$

$$\text{HFC-134a emissions} = 0.00088 \text{ metric tons}$$

$$\text{CO}_2\text{e emissions} = 0.00088 \text{ metric tons} \times 1,300 \text{ GWP} = \underline{\underline{1.144 \text{ metric tons CO}_2\text{e}}}$$

b) HFC-152a (Refrigerators)

$$\text{HFC-152a} = [((0.1 \times 2) \times 0.5\% \text{ EF} \times 1 \text{ year})] / 1,000$$

$$\text{HFC-152a emissions} = 0.000001 \text{ metric tons}$$

$$\text{CO}_2\text{e emissions} = 0.000001 \text{ metric tons} \times 140 \text{ GWP} = \underline{\mathbf{0.00014 \text{ metric tons CO}_2\text{e}}}$$

c) R-407a (Window AC)

$$\text{R-407a} = [((5.0 \times 1) \times 10\% \text{ EF} \times 1 \text{ year})] / 1,000$$

$$\text{R-407a emissions} = 0.0005 \text{ metric tons}$$

$$\text{CO}_2\text{e emissions} = 0.0005 \text{ metric tons} \times 1,526 \text{ GWP} = \underline{\mathbf{0.763 \text{ metric tons CO}_2\text{e}}}$$

$$\text{Total Required Fugitive Emissions} = 1.144 + 0.00014 + 0.763 = \mathbf{1.90714 \text{ metric tons CO}_2\text{e}}$$

GHG Inc.'s entity-wide emissions, excluding fugitive emissions equals 573 metric tons CO₂e, therefore the inventory fraction comprised by their HFCs is equal to 0.33 percent.

$$(1.90714 / [573+1.90714]) \times 100 = \mathbf{0.33\% \text{ of total inventory}}$$

GHG Inc.'s total entity-wide emissions are equal to 574.91 metric tons CO₂e. Their fugitive emissions represent less than 5 percent of their total inventory so the simplified estimation method is appropriate.

d) Optional Scope 2: HFC-134a (Building HVAC)

$$\text{HFC-134a} = [((50 \times 1) \times 15\% \text{ EF} \times 1 \text{ year})] / 1,000$$

$$\text{HFC-134a emissions} = 0.0075 \text{ metric tons}$$

$$\text{CO}_2\text{e emissions} = 0.0075 \text{ metric tons} \times 1,300 \text{ GWP} = \underline{\mathbf{9.75 \text{ metric tons CO}_2\text{e}}}$$

Optional emissions must be reported separately from required emissions.