

**TECHNICAL SUPPORT DOCUMENT FOR
IMPORTS OF FLUORINATED GREENHOUSE
GASES (GHGs), N₂O, AND CO₂ IN PRODUCTS:**

**PROPOSED RULE FOR MANDATORY
REPORTING OF GREENHOUSE GASES**

Office of Air and Radiation
U.S. Environmental Protection Agency

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Contents

1.	Source Description	3
a.	Total Inventory	4
2.	Review of Existing Reporting Programs and Methodologies	5
3.	Types of Products Considered	5
4.	Options for Reporting Threshold	5
5.	Options for Monitoring Methods	8
6.	Procedures for Estimating Missing Data	8
7.	QA/QC Requirements	8
8.	Options for Reporting Procedures.....	8
9.	References	9

1. Source Description

A variety of products containing fluorinated greenhouse gases (GHGs), sulfur hexafluoride (SF₆), nitrous oxide (N₂O), and CO₂ are imported into the United States. In particular, HFCs and SF₆ are used in numerous products, several of which are imported containing the fluorinated GHG. Table 1 provides the number of refrigeration and air-conditioning (AC) units that are projected to be imported into the United States in 2010, as well as the total mtCO₂e of HFCs projected to be imported inside the equipment in that year. The number of refrigeration and AC units imported in 2010 was assumed to equal the number of units imported in 2006. The refrigeration and AC units imported in 2006 were pre-charged with both HFCs and HCFCs. (HCFCs are ozone-depleting substances that are regulated under the Montreal Protocol and are exempt from the proposed definition of fluorinated GHG.) However, by 2010, EPA expects that all imported refrigeration and AC units will be charged with HFCs, because imports pre-charged with HCFCs will not be permitted starting in that year.

Table 1. Projected 2010 Imports of Refrigeration and AC Pre-Charged with HFCs

Product	Number of Units Imported (2010) ^a	Estimated Total GHGs Imported (mtCO ₂ e) (2010)
Dehumidifiers	109,393	28,945
Window ACs	9,028,514	7,379,194
Residential Unitary ACs	359,189	2,556,198
Small Commercial ACs	10,702	121,842
Packaged Terminal AC/Heat Pumps	235,487	250,228
Ice Makers ^b	27,292	90,473
Mobile ACs ^c	2,187,000	2,674,851
Refrigerated Appliances	9,382,646	1,762,530
Small Retail Food	784,281	676,016

Sources: U.S. Department of Transportation (2007) (Mobile ACs)

U.S. Census Bureau (2007) (all other equipment types)

^a Number of imports in 2010 is set equal to reported imports for 2006.

^b Most recent import data is for 2002; 2006 estimate is estimated by applying the percentage of new units (from Vintaging Model) supplied by imports (from Census) in 2002 to the number of 2006 new units (from Vintaging Model).

^c Most recent import data available is for 2005; estimate representative of 2005. Motor vehicle import data excludes imports from Canada and Mexico.

Table 2 provides the estimated amounts of foam containing HFCs and of electrical equipment containing SF₆ that were imported into the United States in 2006, as well as the estimated total mtCO₂e of fluorinated GHGs imported inside these products in 2006.

Table 2. 2006 Foam and Electrical Equipment Imports Containing Fluorinated GHGs

Product	Fluorinated GHG(s)	Estimated Number of Units Imported (2006)	Estimated Total GHG Imported (mtCO ₂ e) (2006)
XPS Boardstock Foam	HFC-134a	20 MM bd-ft.	183,365
XPS Sheet Foam	HFC-152a	2 MM bd-ft.	2,011
PU Rigid Foam: Domestic Refrigeration	HFC-245fa	36 MM bd-ft.	2,420,135
Commercial Refrigeration Foam	HFC-245fa	5 MM bd-ft.	399,067
PU Rigid Foam: Sandwich Panels	HFC-134fa	3 MM bd-ft.	20,708
Circuit Breakers (72.5 kV to 345 kV) ^a	SF ₆	200	30,665
Gas Insulated Substations (GIS)	SF ₆	67	1,858,268

Source: Russell (2008) (Foams)

Bolin (2008) (Electrical Equipment)

^aThis is the only size circuit breaker that is assumed to be imported precharged with SF₆. Larger equipment is not imported with a nominal charge since they are assembled on site in the field; small equipment uses insulators other than SF₆.

As shown in Table 1, HFCs are used as refrigerants in a wide range of AC and refrigeration equipment. In this application, HFCs serve as substitutes for ozone-depleting substances (ODSs), which are being phased out under the Montreal Protocol. Because some ODSs (i.e., HCFCs) are only beginning to be phased out, the use of HFCs in equipment such as window and residential air-conditioners is expected to grow very quickly over the next decade. Imports of pre-charged equipment may grow as well. Although the quantities of chemical contained in each imported unit are small in absolute terms (i.e., a few pounds or less), they are more significant in CO₂-equivalent terms, ranging up to eleven mtCO₂e per unit for pre-charged commercial air-conditioners. (Table 3 below shows the CO₂-equivalent charge size for various types of equipment.) This is due to the high GWPs of the HFCs.

SF₆ is used as an electrical insulator and arc-quenching gas in electrical transmission equipment, including circuit breakers and gas-insulated substations. Again, the quantities of SF₆ in each unit are often small in absolute terms (around 14 pounds per circuit breaker), but are larger in CO₂-equivalent terms (around 150 mtCO₂e per circuit breaker). (Discussions with manufacturers of electrical equipment indicate that some fraction of gas-insulated switchgear may be imported with a holding charge of about one ton of SF₆, equivalent to 28,000 mtCO₂e. However, the extent to which this occurs in practice is uncertain.)

HFCs are also used as blowing agents during the manufacture of foams. Open-cell foams are assumed to emit 100 percent of the blowing agent in the year they are manufactured, whereas closed-cell foams emit only a fraction of their total HFC content upon manufacture. Foam products that are closed celled and imported as a finished foam product therefore have potential to emit the blowing agent remaining in the foam after manufacture and import. Closed cell foams that are imported include: polyurethane (PU) rigid foam used as insulation in domestic refrigerators and freezers; commercial refrigeration foam; PU rigid sandwich panel continuous and discontinuous foam; extruded polystyrene (XPS) sheet foam; and XPS boardstock foam.

Products containing N₂O may also be imported into the United States. N₂O is used primarily in two major end-use applications—1) as a carrier gas with oxygen to administer more potent inhalation anesthetics and as an anesthetic in various dental and veterinary applications, and 2) as a propellant in pressure and aerosol products, the largest application being pressure-packaged whipped cream. As such, imported products containing N₂O may include pre-charged anesthetic equipment for medical applications and in aerosol cans such as pressure-packaged whipped cream products. Other potential imported products containing N₂O may include fuel oxidizer canisters for auto applications and blowtorches containing N₂O used by jewelers and others (Heydorn 1997; EPA 2008).

a. Total Inventory

The number of importers importing products containing fluorinated GHGs varies depending on the gas and product in question. EPA estimates that eight original equipment manufacturers are importing high voltage circuit breakers that contain a holding charge of SF₆ (i.e., estimated as a charge of about 5 psig, which translates into approximately 20-25% of nameplate capacity). It is estimated that approximately 50 entities are importing AC and refrigeration equipment containing a fluorinated GHG refrigerant and foam products containing a fluorinated GHG blowing agent. However, these products are commonly imported and the number of importers could be higher.

EPA estimates that annually, approximately 16 million mtCO₂e of HFCs are imported in pre-charged AC and refrigeration equipment, three million mtCO₂e of SF₆ are imported in pre-charged electrical equipment, and 2.6 mtCO₂e of HFCs are imported in closed-cell foams. Together, these imports are estimated to constitute between five and ten percent of U.S. consumption of fluorinated GHGs. The United States reported consumption of 215 MMTCO₂e of HFCs, PFCs, and SF₆ in 2006 (EPA, 2008).

Although EPA does not have data on the amount of CO₂ or N₂O imported in products (e.g., carbonated sodas and cans of whipped cream), the relatively small quantities of CO₂ or N₂O contained in each unit and the relatively low GWPs of these gases (compared to those of the fluorinated GHGs) imply that the CO₂-equivalent quantities imported are likely to be small both nationally and per importer. This conclusion is supported by the fact that 2006 production and bulk imports of CO₂ and N₂O were one percent or less of those of the fluorinated GHGs in CO₂-equivalent terms (see Technical Support Documents EPA-HQ-OAR-2008-0508-012 and EPA-HQ-OAR-2008-0508-042).

2. Review of Existing Reporting Programs and Methodologies

Protocols/guidance reviewed for this analysis include the *2006 IPCC Guidelines*, Title VI of the Clean Air Act (CAA), Part 75 Appendix D (measurement requirements for oil and natural gas), the Toxic Release Inventory (TRI), the Toxic Substances Control Act (TSCA) Inventory Update Rule, and the Australian Commonwealth Government Ozone Protection and Synthetic Greenhouse Gas Reporting Program.

These programs vary in their treatment of products containing chemicals whose bulk import must be reported. The Australian program requires reporting of all ODSs and GHGs imported in pre-charged equipment, including the type of equipment, the identity of the refrigerant, the number of pieces of equipment, and the charge size. The TSCA Inventory Update Rule requires reporting of chemicals contained in products if the chemical is designed to be released from the product when it is used (e.g., ink from a pen). EPA's ozone protection regulations do not currently require reporting of ODSs contained in imported equipment or other imported products; however, (1) EPA has prohibited the introduction into interstate commerce, including import, of certain non-essential products typically precharged with these chemicals, and (2) EPA is in the process of proposing new regulations to prohibit import of equipment precharged with HCFCs.

For the full review of existing programs, please refer to (EPA-HQ-OAR-2008-0508-054).

3. Types of Products Considered

In determining which products should be subject to reporting, EPA believes it is appropriate to consider three criteria: (1) the quantity of GHGs likely to be imported in the product nationally and per importer, (2) the ease with which the GHG in the product can be identified, and (3) the ease with which the GHG in the product can be quantified.

As noted above, the CO₂-equivalent quantities of CO₂ and N₂O imported in products are likely to be small both nationally and per importer due to the relatively small quantities of CO₂ and N₂O contained in each unit and the relatively low GWPs of these gases (compared to those of the fluorinated GHGs). EPA's review of other protocols and guidance affecting imports did not identify any programs that quantify or restrict imports of CO₂ or N₂O in products.

As discussed above, the quantities of fluorinated GHGs imported in equipment are potentially significant both overall and per product type. For example, EPA estimates that 7 million metric tons CO₂e are imported inside pre-charged window air-conditioners. Other types of equipment that are imported containing significant quantities of fluorinated GHGs include mobile air-conditioners, refrigerated appliances, residential air-conditioners, and gas-insulated switchgear. The identities and amounts of fluorinated GHGs contained in equipment are generally well known; this data is typically listed on the nameplate affixed to every unit. The information is also available in servicing manuals and other paperwork that the importer would be expected to have on file.

Closed cell foams, such as polyurethane (PU) appliance foams (used to insulate refrigerators and freezers) and extruded polystyrene (XPS) insulation boardstock (used to insulate buildings), also contain significant amounts of fluorinated GHGs. Again, manufacturers and importers would generally be expected to be able to identify and quantify the amounts in their imports. (The identities and quantities of chemical inside the foam directly affect its insulating capability.) Since many importers of refrigerators would already be required to report based on the refrigerant contents of the equipment, the additional effort required to track and quantify the GHGs contained in the foam would probably not be excessively burdensome.

4. Options for Reporting Threshold

EPA evaluated a range of threshold options for imports of fluorinated GHGs in products, including thresholds based on the quantity of chemical imported (1,000, 10,000, 25,000, and 100,000 mtCO₂e) and on the number of pieces of equipment imported and/or volume of foam imported (cu ft. or tons). Additionally, EPA considered setting no threshold (requiring reporting of all imports), which is the approach used under the Australian Synthetic Greenhouse Gas Reporting Program.

Table 3 presents the numbers of pieces of equipment that would trigger reporting at various thresholds, assuming that equipment was shipped with the usual shipping charge (either holding charge or full charge). In order to calculate an average CO₂-equivalent charge size for each equipment type, data on gas-specific charge sizes were first collected from three separate sources, depending on the equipment type. For refrigeration and AC equipment,

charge size estimates were taken from EPA's Vintaging Model (VM) (EPA 2008). The average charge size of each foam type was estimated based on engineering judgment (ICF 2008b). For SF₆-containing equipment (i.e., circuit breakers and gas insulated substations), the average charge size was calculated using the assumption provided by Phil Bolin (2008) that the average shipping charge is 20 percent of the equipment's total nameplate capacity. These data were then weighted by the percentage of new units in 2010 using the relevant gas, as estimated by EPA's VM, for each equipment type. Finally, the charge sizes were converted in mtCO₂e using SAR GWPs and summed to develop an average CO₂-equivalent charge size for each equipment type. The numbers of pieces of equipment to trigger reporting at various thresholds is simply the threshold divided by this calculated average charge size.

EPA believes that a threshold based on the total quantity of chemical imported is likely to be more practical and equitable than one based on the number of pieces of equipment or volume of foam imported. This is because importers may import multiple types of equipment and/or foam, which may contain different quantities of refrigerant and/or blowing agent per unit. If a threshold based on numbers of pieces of equipment were established, it could exclude importers who imported large quantities of GHGs spread out among multiple types of equipment. Alternatively, it could require a complicated formula to prevent such exclusions.

Table 4 presents the total masses of HFCs and SF₆, in mtCO₂e, that EPA estimates are contained in imported pre-charged equipment, both nationally and by importer. The amount of total gas imported was estimated by summing the product of the average charge size (as detailed above) and the quantity of imports (as detailed in Table 1 and 2) for each equipment type. Where imported products include foam as well as refrigerant (e.g., household refrigerators), the fluorinated GHG in the foam was also included. Information on the number of importers was obtained from ICF (2008a) for HFC equipment and from Phil Bolin (2008) for SF₆ equipment. In the absence of importer-specific data, the analysis below assumes that each importer imports the same quantity of HFC or SF₆ equipment. In addition, Table 3 presents the masses of GHGs contained in imported equipment that would be included under each threshold.

Based on the assumptions outlined above, all importers of equipment pre-charged with HFCs or SF₆ would be required to report all imports of this equipment under all thresholds considered. In reality, imports are likely to be concentrated among a relatively small number of equipment importers, decreasing the number of reporters and the imports reported. This is the pattern that EPA has seen for bulk imports of fluorinated GHGs, where approximately 40 percent of the importers import almost 100 percent of the imports at an import threshold of 25,000 mtCO₂e (Technical Support Document EPA-HQ-OAR-2008-0508-042). In general, as thresholds decrease, smaller importers representing successively smaller shares of total national imports are required to report. The drawback of requiring reporting of all imports (i.e., setting no threshold) is that it could substantially increase the burden of the rule without substantially increasing the quantity of imports reported.

Table 3. Equipment Import Threshold Summary: Quantities of Equipment Required to Meet Thresholds (Based on Average Charge Size)

Equipment	Dehumidifiers	Window ACs	Residential Unitary ACs	Small Commercial ACs	Packaged Terminal AC/Heat Pumps	Ice Makers	Mobile ACs	Refrigerated Appliances	Small Retail Food	PU Rigid Sandwich Panels	Commercial Refrigeration	PU Rigid (Domestic Refrigeration)	XPS Sheet	XPS Boardstock	Circuit Breakers (34 kV to 72.5 kV)	Gas Insulated Substations (GIS)
Average Charge Size (mtCO ₂ e)	0.3	0.8	7.1	11.4	1.1	3.3	1.2	0.2	0.9	0.1 ^a	1.0 ^a	0.8 ^a	0.01 ^a	0.1 ^a	153.3	27874
1,000	3,779	1,224	141	88	941	302	818	5,323	1,160	12,073	1,044	1,240	82,881	9,089	7	
10,000	37,793	12,235	1,405	878	9,411	3,017	8,176	53,234	11,602	120,727	10,441	12,396	828,805	90,894	65	
25,000	94,483	30,588	3,513	2,196	23,527	7,541	20,440	133,085	29,004	301,818	26,103	30,990	2,072,013	227,234	163	
100,000	377,931	122,351	14,052	8,783	94,109	30,166	81,762	532,340	116,015	1,207,271	104,410	123,960	8,288,053	908,935	652	

^a Average charge for closed-cell foam products is provided in cubic feet.

Table 4. Equipment Import Threshold Summary: Masses of GHGs that Would be covered by the Various Thresholds

Equipment Type	Imports (mtCO ₂ e)	Number of Importers	GHG per Importer (mtCO ₂ e)	Total Amount Meeting Threshold (mtCO ₂ e)			
				1,000	10,000	25,000	100,000
All HFC Equipment ^a	18,359,480	50	367,190	18,359,480	18,359,480	18,359,480	18,359,480
All SF ₆ Equipment	1,888,932	8	236,116	1,888,932	1,888,932	1,888,932	1,888,932

^a Includes precharged refrigeration and AC equipment, and foams used in refrigeration equipment (commercial refrigeration foam and PU Rigid Domestic Refrigeration foam).

5. Options for Monitoring Methods

Options for tracking imports and exports of products include reporting the total amount of each fluorinated GHG imported inside the products and/or the quantity of the product imported (e.g., number of pieces of equipment) along with information on the identity and quantity of the fluorinated GHG in each unit or piece. EPA has reviewed existing reporting programs and methodologies that take one or both of these approaches, as described above.

The quantities of fluorinated GHGs contained in imported products could be reported by chemical in tons or in mtCO₂e. Reporting in tons of chemical would provide more transparency and reduce mistakes such as arithmetic errors or the use of inappropriate GWPs. Persons importing equipment that contained both a fluorinated GHG refrigerant and a foam blown with a fluorinated GHG (e.g., household refrigerators) could separately report these GHGs (which are generally different). Similarly, total exports of chemical actually contained in exported equipment, foams, or other products could be reported by exporters, by chemical in tons or mtCO₂e.

The equation below could be used to estimate each importer's imports of each fluorinated GHG inside equipment or foams:

$$I = \sum_t S_t * N_t * 0.001$$

Where:

I	=	Total amount of the fluorinated GHG imported by the importer annually (metric tons)
t	=	Type of equipment/foam containing the fluorinated GHG
S _t	=	Shipping charge per unit of equipment or foam type t
N _t	=	Number of units of equipment or foam type t imported annually
0.001	=	Factor converting kg to metric tons

As is the case for bulk imports, any trans-shipments (i.e., products containing GHGs that originate in a foreign country and enter the United States en route to an ultimate destination in another foreign country) could be exempt from reporting. Similarly, importers of products containing fluorinated GHGs could report their imports on the corporate level.

6. Procedures for Estimating Missing Data

A complete record of all measured parameters used in the GHG emissions calculations would be required; no data should be missing as the data are required for importing and exporting in the United States.

7. QA/QC Requirements

Options for QA/QC requirements includes reviewing inputs to the annual submission against the import and export transaction records to ensure that the information submitted to EPA is being accurately transcribed as the correct chemical or blend in the correct units and quantities (metric tons).

8. Options for Reporting Procedures

Along with their formal report, importers could be required to submit the following supplemental data to document and verify their import estimates:

- Quantities of products imported, in appropriate units;
- The name of the fluorinated GHG, charge size (holding charge, if applicable), and number imported for each type of equipment; and
- The name of the fluorinated GHG, and the quantity imported (cu. ft and kg/ft² or tons) for each type of foam.

Importers could be required to keep the following records to document and verify their import estimates:

- The information reported (as indicated above);
- The port of entry through which the fluorinated GHGs passed;
- The country from which the imported fluorinated GHGs were imported;
- The importer number for the shipment;
- A copy of the bill of lading for the import;
- The invoice for the import; and
- The U.S. Customs entry form.

Along with their formal report, exporters could be required to submit the following supplemental data to document and verify their export estimates:

- Quantities of products exported, in appropriate units;
- The name of the fluorinated GHG, charge size (holding charge, if applicable), and number imported for each type of equipment; and
- The name of the fluorinated GHG, and the quantity imported (cu. Ft and kg/ft² or tons) for each type of foam.

Exporters could be required to keep the following records to document and verify their export estimates:

- The information reported above;
- The names and addresses of the exporter and the recipient of the exports;
- The exporter's Employee Identification Number;
- The date on which, and the port from which, the products containing the fluorinated GHGs were exported from the United States or its territories;
- The country to which the products containing the fluorinated GHGs were exported; and
- The invoice for the export.

Persons who transship products containing fluorinated GHGs could be required to maintain records that indicated that the products originated in a foreign country and was destined for another foreign country and did not enter into commerce in the United States.

9. References

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