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Greenhouse Gas Emissions Reporting

Technical Guidance on Reporting Greenhouse Gas Emissions

2005 Reporting Year

Canada

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The Greenhouse Gas Emissions Reporting Initiative is a partnership between the Government of Canada and provincial and territorial governments. It is being designed and tested to ensure that it meets the needs of all jurisdictions, avoids duplication and minimizes the burden on both Canadian industry and governments alike.

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GLOSSARY OF TERMS

The following words and terms used in this guidance document shall have the indicated meaning:

Biomass is defined as plant materials, animal waste or any product made of either of these. This includes (but is not necessarily limited to) wood and wood products; charcoal and agricultural residues and wastes (including organic material above and below ground, both living and dead, such as trees, crops, grasses, tree litter, roots, etc.); municipal and industrial wastes (where the organic material is biological in origin); landfill gas; bio-alcohols; black liquor; sludge gas; and animal- or plant-derived oils.

Carbon dioxide equivalent (CO_2e or CO_2 eq.) is a unit of measure used to allow the addition of or the comparison between different gases that have global warming potentials (GWPs). Since many greenhouse gases (GHGs) exist and their GWPs vary, the emissions are added in a common unit, CO_2 equivalent. To express GHG emissions in units of CO_2 equivalent, the quantity of a given GHG (expressed in units of mass) is multiplied by its GWP.

Contiguous facility means all buildings (including office buildings), equipment, structures and stationary items that are located on a single site or on contiguous or adjacent sites, that are owned or operated by the same person and that function as a single integrated site, and it includes wastewater collection systems that discharge treated or untreated wastewater into surface waters.

Direct emissions refer to emissions from those sources that are actually located at the reporting facility.

Electronic data reporting (EDR) system refers to the secure on-line reporting system to be used by reporters to submit the required information under Phase 1 of the mandatory GHG reporting system (site developed and hosted by Statistics Canada).

Equipment includes transportation machinery integral to the production process(es) carried on at the facility.

Facility means a contiguous facility, a pipeline transportation system or an offshore installation.

Global warming potential (GWP) is a relative measure of the warming effect that the emission of a GHG might have on the Earth's atmosphere.[1] It is calculated as the ratio of radiative forcing (i.e. the amount of heat-trapping potential)[2] that would result from the emission of 1 kg of a given GHG to that from the emission of 1 kg of CO_2. For example, the GWP for nitrous oxide (N_2O) is 310, which means that 1 kg of N_2O emissions is equivalent to 310 kg of CO_2 emissions.

Large final emitters (LFE) refers to a proposed federal government system, currently under development, to reduce annual GHG emissions by key industrial sectors, such as oil and gas, electricity production, and mining and manufacturing. The system would require mandatory GHG emissions reductions using an intensity-based approach.

1 Olsen et al. (2003); additional information is available at http://www.ec.gc.ca/pdb/ghg/ghg_home_e.cfm.

2 Radiative forcing is measured in units of power (watts) per unit of area (square metres). The radiative forcing effect of a gas within the atmosphere is a reflection of its ability to cause atmospheric warming.

Offshore installation means an offshore drilling unit, production platform or ship, or sub-sea installation attached or anchored to the continental shelf of Canada in connection with the exploitation of oil or gas.

Pipeline transportation system means all pipelines transporting processed natural gas and their associated installations (including storage facilities but excluding straddle plants or other processing installations) that are under single ownership within a province or territory; for example, a natural gas transmission company that has several pipeline operations or networks within and across several provinces is to use the provincial boundaries to identify its "pipeline transportation systems."

PREFACE

Background

Canada has announced that it intends to work towards fulfilling its obligations and domestic climate change policy objectives by ensuring that it has the capacity to quantify, track and report progress on the reduction of greenhouse gas (GHG) emissions in a way that meets a required level of accuracy, thoroughness, transparency and public credibility.

In the *Canada Gazette* notice published in March 2004, the Government of Canada announced the first phase of mandatory reporting of GHG emissions. The first phase focuses on a limited number of emitters and basic reporting requirements and lays the foundation for the development of a harmonized and efficient domestic mandatory reporting system for GHG emissions. Phase 1 will focus on facilities that emit 100 kilotonnes of carbon dioxide equivalent or more annually, referred to as the reporting threshold. Reports of GHG emissions for 2004 will be due by June 1, 2005.

Through consultation, there was broad consensus that federal, provincial and territorial governments should be working in partnership to develop a single-window domestic reporting system that is efficient and harmonized and that would meet the following four key objectives:

1. document and record information to support the proposed federal system for large final emitters;
2. meet provincial and territorial reporting requirements for GHG emissions and related information;
3. increase the level of detail and improve the precision of the National Greenhouse Gas Inventory; and
4. provide Canadians with reliable and timely information on GHG emissions.

With mandatory reporting systems already in existence in the provinces of Ontario and Alberta, the federal, provincial and territorial governments recognize the need for a harmonized GHG reporting system. Governments in consultation with stakeholders are working to define a process for a single GHG reporting system that will meet the reporting needs of all jurisdictions and minimize the reporting burden for both Canadian industry and government.

Purpose

The main purpose of this document is to provide guidance to help reporters determine if they are required to submit a report and to present technical information related to the GHG emissions to be reported and the required reporting format. This technical information includes the GHG types and emission sources covered, along with information on methods for calculating emissions. An overview of the reporting process is also described herein. The electronic data reporting system will provide more detailed reporting instructions on how to complete and submit the report form and other relevant information.

1 REPORTING PROCESS OVERVIEW

To respond to the requirements under Phase 1 of the mandatory greenhouse gas (GHG) reporting system, a facility is required to complete a number of steps, which are briefly described below (see also Figure 1):

1. Calculate the facility's total direct emissions in carbon dioxide equivalent (CO_2 eq.), for calendar year 2004, for the GHG types covered under Phase 1 of the reporting system.
2. Determine whether the facility's emissions meet or exceed the reporting threshold:
   a) If the facility's emissions meet or exceed the threshold, the facility is required to submit a report for its 2004 emissions (continue to Step 3).
   b) If the facility's emissions fall below the threshold, the facility is not required to register or submit a report for its 2004 emissions.
3. Complete the registration step to receive a facility ID to log in to the electronic data reporting (EDR) system. Each facility that is subject to the reporting requirement will need to be registered. In this registration process, the reporter will be asked to provide general information, such as:
   - reporter identification (e.g. name, position, contact information, preferred language of correspondence);
   - reporting company name (e.g. legal and trade names) and;
   - facility information (e.g. name, physical location).
4. Log in to the EDR system using the facility ID obtained in the registration process, create a password and complete the report form[3] for the facility. The reporter will be asked to provide the following information:
   - reporting company's business number, relevant facility identifiers;
   - main sector of activities (the reporter will need to select from a list provided) and North American Industry Classification System (NAICS) code.
   - parent company information (e.g. name, address, percent ownership, etc.);
   - public contact and certifying official information (e.g. name, address, etc.); and
   - GHG emissions information (e.g. emissions data, calculation methodologies used, etc.).

The list of main sectors of activities mentioned above includes those activities that represent the primary sources of emissions likely to be subject to GHG reduction targets under the proposed federal system for large final emitters (LFEs).

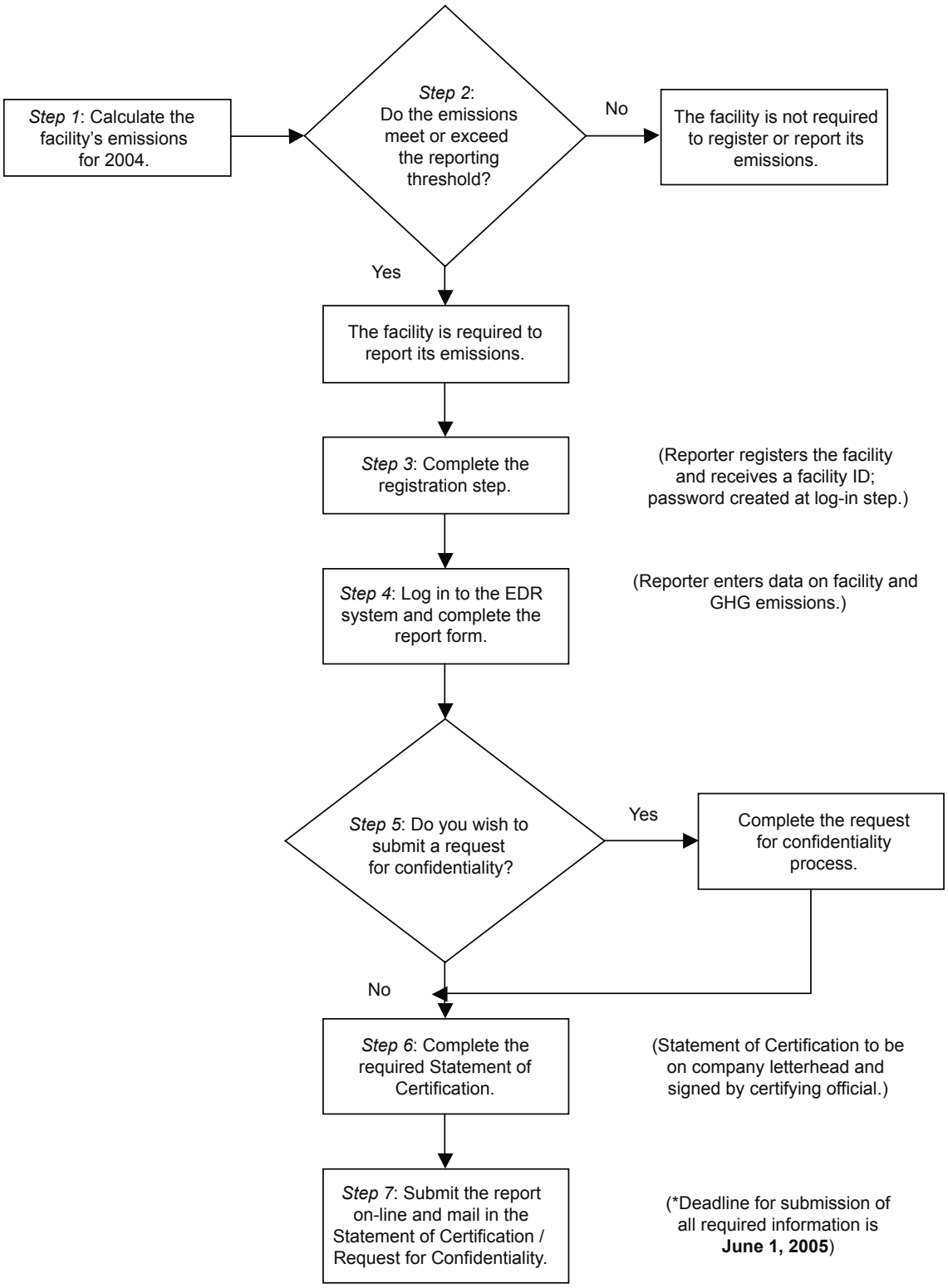
Facilities are required to report total GHG emissions for the facility as per the reporting format described in this document. For two of the emission categories used, reporters can also provide further details on sub-components of these categories (see Section 4.0). Providing such details will help to ensure that the reporting application developed under Phase 1 (and the ultimate GHG reporting system) is in line with the proposed LFE system.

3 The EDR system will provide specific instructions on how to fill out the form and other relevant information.

5. Complete the request for confidentiality step if the reporter wishes to submit a request that the reported information be kept confidential (appropriate justification will be required).
6. Complete the required Statement of Certification by printing the statement on company letterhead and having the certifying official sign the statement.
7. Submit the report form on-line and mail in the signed Statement of Certification and, if applicable, the request for confidentiality. **All information must be submitted and/or postmarked by June 1, 2005**.

If a reporter experiences problems with the on-line reporting application, a Help Line will be available to provide technical assistance.

Figure 1: Overview of Reporting Process



2 BASIC CONCEPTS FOR REPORTING EMISSIONS

2.1 Relationship with UNFCCC and IPCC

The federal government has the responsibility for the development and maintenance of a reliable, accurate and credible National Greenhouse Gas Inventory as part of its obligations under the United Nations Framework Convention on Climate Change (UNFCCC), the first binding international legal instrument that deals directly with climate change[4]. To fulfil this obligation, Canada must report its national GHG emissions according to the comprehensive guidance provided by the UNFCCC, which includes reference to two key technical documents — *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*[5] (IPCC/OECD/IEA, 1997) and *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*[6] (IPCC, 2000). These documents were developed by the Intergovernmental Panel on Climate Change (IPCC).[7]

Under Phase 1 of the mandatory GHG reporting, no specific estimation methods are prescribed. Reporters can choose the quantification methodologies most appropriate for their own particular industry or application. However, reporting facilities are encouraged to use methods for estimating emissions that are consistent with the guidelines adopted by the UNFCCC for the preparation of national GHG inventories, as discussed above.

The IPCC Guidelines and Good Practice Guidance[8] describe various approaches to estimating GHG emissions at the national level, which can be applied at the facility level. These documents are available at the following link: http://www.ipcc-nggip.iges.or.jp/public/public.htm.

It is important to note that the Kyoto Protocol (the new agreement drafted by the Parties to the UNFCCC in 1997), commits Canada to a 6% reduction from 1990 GHG emissions by the period 2008–2012 (the "first commitment period") and stipulates that progress in achieving this reduction commitment will be measured through the use of a set of internationally agreed to emissions and removals inventory methodologies and reporting guidelines for national inventories, which are more robust than those that currently exist under the UNFCCC.

2.2 Key Elements in Calculating Emissions

Key characteristics of the IPCC Guidelines and Good Practice Guidance that are considered useful for reporters to recall when calculating the facility's GHG emissions include the following:

1. *The availability of a number of differing "tiers" of calculation methods*
   For various categories of emission sources, there are several ways of calculating the emissions, described as tiers (e.g. Tier 1, Tier 2, Tier 3), and each tier has an associated increasing level of detail and accuracy.

4 The UNFCCC was adopted at the June 1992 "Earth Summit" in Rio de Janeiro and has been in force since March 1994. The Convention's ultimate objective is the "stabilization of greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (United Nations, 1992).

5 Referred to as the IPCC Guidelines throughout the remainder of this document.

6 Referred to as the Good Practice Guidance throughout the remainder of this document.

7 The IPCC, established in 1988 by the World Meteorological Organization and the United Nations Environment Programme, makes periodic assessments of the climate change issue and reports to governments as appropriate. It also provides scientific and technical advice to the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change.

8 The IPCC Guidelines consist of three volumes, and the Reference Manual (Volume 3) contains information on GHG estimation methods. The Good Practice Guidance provides a reference that complements the IPCC Guidelines.

2. *The encouragement of the use of specific emission factors*[9] *or data*
   To evaluate GHG emissions, "default emission factors" are provided for many different fuels and activities. These default emission factors are considered to be less accurate than country-specific and, in turn, process-specific factors. Reporters are encouraged to use emission factors and data specific to a country[10] or, better yet, an industry or technology.

3. *A focus on the prioritization of effort*
   The IPCC suggests that the most effort on quantifying emissions should be spent on those sources that are the most critical — i.e. those that make up the largest quantity, are responsible for the greatest increase or decrease or have associated with them the highest level of uncertainty.

Although comprehensive and rigorous, the IPCC Guidelines maintain a flexible approach to GHG calculation procedures. The prioritization of emission sources of greatest importance is also emphasized. In prioritizing the work, these guidelines recognize that the more specific the emission factor or methodology (in terms of geography, facility or process), the better the emission estimate will be.

2.3 Prioritizing Efforts

In the spirit of the IPCC Guidelines, reporters to Phase 1 are encouraged to prioritize their efforts when calculating their GHG emissions. This concept can be applied by identifying the emission sources of greatest significance at the facility and using a higher level of effort when calculating emissions from these sources. Since these emission sources have a greater impact on the totals, the use of more detailed methods would be appropriate. For example, for significant sources, efforts could be expended on using facility- or process-specific emission factors or estimation methods, if available, as opposed to general or default emission factors or estimation methods. Applying a lower level of effort (i.e. less detailed methods) to calculate emissions for less significant sources would minimize the impact on the overall total and its level of accuracy.

Since no absolute quantification standards are prescribed at this point, reporters can be flexible in their choice of emission calculation procedures. It is recognized that the approaches chosen will depend to a certain extent on the information available for the facility. Although all required gases must be reported on (see section 3.0), reporters are reminded that they are required to report only information to which they would reasonably be expected to have access. For example, perfluorocarbons (PFCs) and hydrofluorocarbons (HFCs) are usually emitted in very small amounts relative to other GHGs. The efforts to capture such emissions are expected to vary, depending on if the facility emits significant amounts of such gases (e.g. in the production of aluminium) or if the facility has reasonable access to the emissions data.

2.4 Biomass Emission Considerations

2.4.1 Combustion

In accordance with UNFCCC and IPCC reporting guidelines, special consideration is necessary when reporting CO_2 emissions from biomass to ensure that there is no double counting. These guidelines, which the Government of Canada is bound to use, require the reporting (although not the counting) of CO_2 emissions resulting from the combustion of biomass materials. These emissions are not included in the national total, as it is assumed that the biomass is produced in a sustainable manner. That is, combusted biomass is replaced by growing biomass, which in turn reabsorbs the same amount of atmospheric carbon as was given off by the combusted material.[11]

9 An emission factor is a factor by which certain data, such as the fuel quantity combusted, can be multiplied to estimate the GHG emissions.

10 Environment Canada uses various emission factors that are specific to Canada for estimating emissions from several emission sources (for more details, see the latest National Greenhouse Gas Inventory report at http://www.ec.gc.ca/pdb/ghg/inventories_e.cfm)

11 For information purposes in the National Greenhouse Gas Inventory, if biomass materials are harvested at an unsustainable rate, net CO_2 emissions are accounted for as a loss of biomass stocks in the Agriculture or Land-Use Change and Forestry sector.

In the same manner, reporters are required to report CO_2 emissions from biomass combustion. However, due to the assumption of sustainable harvesting, it is listed separately as a "memo item" and is not included in the emission totals. This explicit reporting of CO_2 from biomass-based combustion has the benefits of:

- reminding reporters that these emissions need to be reported internationally;
- ensuring that CO_2 emissions from biomass are not counted in the totals; and
- demonstrating the quantity of atmospheric CO_2 loading that has been avoided.

On the other hand, as is required under the IPCC Guidelines, facilities must report *and* count methane (CH_4) and nitrous oxide (N_2O) emissions from biomass combustion. There is no reverse, biogenic mechanism by which replacement biomass removes these emissions from the atmosphere. Therefore, they must be included in the GHG totals in the same way as CH_4 and N_2O combustion emissions from any other fuel.

2.4.2 Waste

Under the mandatory GHG reporting program, GHG emissions from biomass waste decomposition are required to be reported. Reported and counted emissions are to include CH_4 and N_2O. Aerobic decomposition of waste can emit substantial quantities of CO_2, but these emissions need not be reported. Also, CO_2 emissions from the biomass portion of waste that may be incinerated on-site are to be reported but are *not* counted in the emission totals.

Reporting facilities will find specific details in section 4.0 on how to handle emissions from biomass under Phase 1 of the mandatory reporting system.

2.5 Auditing and Verification

For Phase 1 of the mandatory GHG reporting system, there are no specific requirements for a facility to have its emissions verified by a third party. The information reported by a facility should be verifiable, which means that any information that would allow a facility's emissions to be verified by either the government or a third party certified by the government to do such verifications should be retained. Facilities can choose to have their emissions verified by a third party if they wish.

Reporters are required to keep copies of the requested information, together with any calculations, measurements and other data on which the information is based, at the facility to which it relates or at that facility's parent company, located in Canada. All information must be kept for a period of three years from the date the reporting requirement came into force (March 13, 2004).

Reporters are also required to submit a Statement of Certification, signed by an authorized official, stating that the information contained in the attached emission report is accurate and complete, to the best of their knowledge.

3 REPORTING CRITERIA

3.1 Reporting Threshold

A facility needs to determine whether it is required to report under Phase 1 of the mandatory GHG reporting system. The reporting threshold for Phase 1 is 100 kilotonnes of CO_2 equivalent (100 kt CO_2 eq.). A facility is required to submit a report if its emissions of the GHGs covered by the reporting system (see section 3.2), in calendar year 2004, meet or exceed the reporting threshold.

To complete this assessment, it is necessary for the facility to calculate its total emissions in calendar year 2004 for the GHG types and emission sources covered. Total emissions are calculated as the sum total mass of each of the gases or gas species multiplied by their respective global warming potentials (GWPs). The following equation is to be used:

Emissions of individual species of HFCs and PFCs must be quantified separately and then multiplied by their GWPs.

CO_2 emissions from biomass materials, as discussed in section 2.4, should *not* be included in this determination of total emissions for the purposes of assessing whether a facility meets or exceeds the reporting threshold. However, these CO_2 emissions should be quantified and reported separately as part of the reportable GHG information (see section 4.0).

3.2 Greenhouse Gases Covered

The GHGs that are subject to mandatory reporting under Phase 1 are listed in Table 1. The GWPs[12] and CAS numbers[13] for these GHGs are also listed in the table.

$$Total\ Emissions = \sum_{1}^{i} (E_{CO_2} \times GWP_{CO_2})_i + \sum_{1}^{i} (E_{CH_4} \times GWP_{CH_4})_i + \sum_{1}^{i} (E_{N_2O} \times GWP_{N_2O})_i +$$
$$\sum_{1}^{i} (E_{PFC} \times GWP_{PFC})_i + \sum_{1}^{i} (E_{HFC} \times GWP_{HFC})_i + \sum_{1}^{i} (E_{SF_6} \times GWP_{SF_6})_i$$

where:

E = total emissions of a particulargas or gas species from the facility (kilotonnes);

GWP = global warming potential of the same gas or gas species (see section 3.2);

i = each emission source.

12 GWPs in Table 1 are from IPCC (1996).

13 The CAS number (or CAS registry number) refers to the Chemical Abstracts Service number, a unique numerical identifier that is given to a chemical compound. The Chemical Abstracts Service, a division of the American Chemical Society, assigns these identifiers to every chemical that has been described in the literature.

Table 1: Greenhouse Gases and Gas Species Subject to Mandatory Reporting

Greenhouse Gas	Formula	CAS No.	GWP
Carbon dioxide	CO_2	124-38-9	1
Methane	CH_4	74-82-8	21
Nitrous oxide	N_2O	10024-97-2	310
Sulphur hexafluoride	SF_6	2551-62-4	23 900
Hydrofluorocarbons (HFCs):			
HFC-23 (trifluoromethane)	CHF_3	75-46-7	11 700
HFC-32 (difluoromethane)	CH_2F_2	75-10-5	650
HFC-41 (fluoromethane)	CH_3F	593-53-3	150
HFC-43-10mee (1,1,1,2,3,4,4,5,5,5-decafluoropentane)	$C_5H_2F_{10}$	138495-42-8	1 300
HFC-125 (pentafluoroethane)	C_2HF5	354-33-6	2 800
HFC-134 (1,1,2,2-tetrafluoroethane)	$C_2H_2F_4$ (Structure: CHF_2CHF_2)	359-35-3	1 000
HFC-134a (1,1,1,2-tetrafluoroethane)	$C_2H_2F_4$ (Structure: CH_2FCF_3)	811-97-2	1 300
HFC-143 (1,1,2-trifluoroethane)	$C_2H_3F_3$ (Structure: CHF_2CH_2F)	430-66-0	300
HFC-143a (1,1,1-trifluoroethane)	$C_2H_3F_3$ (Structure: CF_3CH_3)	420-46-2	3 800
HFC-152a (1,1-difluoroethane)	$C_2H_4F_2$ (Structure: CH_3CHF_2)	75-37-6	140
HFC-227ea (1,1,1,2,3,3,3-heptafluoropropane)	C_3HF_7	431-89-0	2 900
HFC-236fa (1,1,1,3,3,3-hexafluoropropane)	$C_3H_2F_6$	690-39-1	6 300
HFC-245ca (1,1,2,2,3-pentafluoropropane)	$C_3H_3F_5$	679-86-7	560
Perfluorocarbons (PFCs):			
Perfluoromethane (tetrafluoromethane)	CF_4	75-73-0	6 500
Perfluoroethane (hexafluoroethane)	C_2F_6	76-16-4	9 200
Perfluoropropane (octafluoropropane)	C_3F_8	76-19-7	7 000
Perfluorobutane (decafluorobutane)	C_4F_{10}	355-25-9	7 000
Perfluorocyclobutane (octafluorocyclobutane)	$c\text{-}C_4F_8$	115-25-3	8 700
Perfluoropentane (dodecafluoropentane)	C_5F_{12}	678-26-2	7 500
Perfluorohexane (tetradecafluorohexane)	C_6F_{14}	355-42-0	7 400

4 EMISSIONS REPORTING FORMAT

4.1 Reporting Emissions Data

To enter GHG emissions data, the reporter will input numerical values (in units of tonnes) for the emission sources occurring at the facility (up to 8 digits in front of the decimal and up to 4 digits after the decimal can be entered). The quantity of emissions in CO_2 equivalent units will be automatically calculated by the EDR system.

A not applicable (N/A) box will be available for each emission source category and gas listed, and the reporter may select this box only in those cases where:

- the emission source or emission type does not occur at the facility; or
- the emissions from a given source are not estimated due to the unavailability of data.

If a reporter has calculated the emissions for a given category or gas type and the emissions are zero, the reporter is to enter the digit "0" in the relevant numeric field.

Figure 2 is a sample of the layout of the GHG emissions section to be used in the report form.

4.2 Carbon Dioxide, Methane and Nitrous Oxide Emissions

The reporting facility needs to calculate and report its direct emissions of the three gases CO_2, CH_4 and N_2O individually. When reporting these emissions, the reporter is required to disaggregate the emissions by the following source categories:

- Stationary Combustion
- Industrial Process
- Fugitive
- Other

Additional information on each of these categories is provided in the following subsections.

Figure 2: Sample of GHG Emissions Data Layout

Total Stationary Combustion Emissions

	N/A	Tonnes	Tonnes (in CO_2e)
Carbon dioxide (CO_2)	❑		
Methane (CH_4)	❑		
Nitrous oxide (N_2O)	❑		
			total:

Total Industrial Process Emissions

	N/A	Tonnes	Tonnes (in CO_2e)
Carbon dioxide (CO_2)	❑		
Methane (CH_4)	❑		
Nitrous oxide (N_2O)	❑		
			total:

Total Fugitive Emissions

	N/A	Tonnes	Tonnes (in CO_2e)
Carbon dioxide (CO_2)	❑		
Methane (CH_4)	❑		
Nitrous oxide (N_2O)	❑		
			total:

Of the Total Fugitive Emissions reported above, how much was from Venting and Flaring? (non-mandatory)

Venting & Flaring Emissions

	N/A	Tonnes	Tonnes (in CO_2e)
Carbon dioxide (CO_2)	❑		
Methane (CH_4)	❑		
Nitrous oxide (N_2O)	❑		
			total:

Total Other Emissions

	N/A	Tonnes	Tonnes (in CO_2e)
Carbon dioxide (CO_2)*	❑		
Methane (CH_4)	❑		
Nitrous oxide (N_2O)	❑		
			total:

Of the Total Other Emissions reported above, how much was from On-Site Transportation? (non-mandatory)

On-Site Transportation Emissions

	N/A	Tonnes	Tonnes (in CO_2e)
Carbon dioxide (CO_2)	❑		
Methane (CH_4)	❑		
Nitrous oxide (N_2O)	❑		
			total:

Biomass Emissions *(Not included in total)*

	N/A	Tonnes	Tonnes (in CO_2e)
Carbon dioxide from biomass (CO_2)	❑		

4.2.1 Stationary Combustion Emissions

This category includes emissions from non-vehicular combustion sources occurring at the facility, where the fuel is burned for the purpose of producing energy (e.g. to generate electricity, heat or steam). This includes on-site waste incineration if the waste is combusted for energy. Emissions from waste incineration used as a disposal method are included under the Other Emissions category (see section 4.2.4). Special consideration is needed for CO_2 emissions from the combustion of biomass (see section 4.2.5).

This category of emissions is a common, cross-sector type; it is likely that most facilities in the various sectors have operations on-site that produce this type of emissions.

4.2.2 Industrial Process Emissions

This category refers to emissions from an industrial process involving chemical reactions other than combustion and where the primary purpose of the industrial process is not energy production. Examples of industrial processes that represent sources of this category of emissions include mineral production (e.g. cement, lime), metal production (e.g. iron and steel, aluminium) and chemical production (e.g. adipic acid, nitric acid).

This category of emissions is expected to be more unique to specific sectors and to specific facilities in a given sector, depending on the operations performed at the facility.

Note: In instances where industrial process emissions are produced in combination with emissions from fuel combusted for energy purposes, the emissions should be categorized according to the primary purpose of the activity — either "energy" or "process."[14] If the primary purpose is the generation of energy, the emissions are included under Stationary Combustion Emissions, and if it is process-related, the emissions are included under Industrial Process Emissions. The reduction of iron in a blast furnace through the oxidation of coke is an example. Invariably, the heat released is used within the process or for other energy needs; however, in this case, since the primary purpose of coke oxidation is to produce pig iron, the emissions are categorized as Industrial Process Emissions.

4.2.3 Fugitive Emissions

Fugitive emissions are defined as intentional (e.g. venting and flaring) or unintentional (e.g. leaks) releases of gases from industrial activities. In particular, they may arise from the production, processing, transmission, storage and use of fuels and include emissions from combustion only when it does not support a productive activity (e.g. flaring of natural gases at oil and gas production facilities). Reporters are required to enter their total fugitive emissions in the report form.

Venting and flaring emissions represent a source of emissions likely to be covered under the proposed LFE system. These emissions may also be reported separately in the EDR application (non-mandatory).

4.2.4 Other Emissions

This category refers to any direct emissions that do not fall under Stationary Combustion Emissions, Industrial Process Emissions or Fugitive Emissions. Included are emissions from on-site (i.e. at the facility) disposal of waste and waste or wastewater treatment; and emissions from transportation that is integral to the production process.

On-site waste disposal and waste or wastewater treatment activities that are sources of emissions at a facility may include landfilling of solid waste, treatment of liquid waste and waste incineration. GHG emissions from waste-to-energy, where waste material is used directly as fuel or converted into a fuel, must be calculated and reported under Stationary Combustion Emissions. There are emissions of CO_2, CH_4 and N_2O from waste disposal, and special consideration is necessary for CO_2 emissions originating from biomass materials in waste (see section 4.2.5).

On-site transportation emissions are emissions that result from transportation that is integral to

14 This distinction is in accordance with that provided in Volume 1, Reporting Instructions, of IPCC/OECD/IEA (1997: p. 2.1).

the production process. This includes transport activities occurring on-site (i.e. at the facility) where emissions of CO_2, CH_4 and N_2O result from the associated fuel combustion processes. The terminology "integral to the production process" means transporting raw or intermediate products and materials within the production process.

Examples of such activities may include:

- equipment used at a steel mill to move molten metal to different stages in the steel production process;
- equipment used at oil sands operations to mine and/or move oil sand or other materials to subsequent on-site processes (e.g. crushing, extraction); and
- equipment used at above- or below-ground mining operations to mine and/or move mined materials or other intermediate products or materials to different on-site production processes.

Reporters are required to report their total Other emissions in the report form.

On-site transportation emissions may represent a source of emissions likely to be covered under the proposed LFE system. These emissions may also be reported separately in the EDR application (non-mandatory).

4.2.5 Memo Item — CO_2 Emissions from Biomass

(i) CO_2 Emissions from Combustion of Biomass

The facility may use biomass materials as a fuel source in its combustion processes on-site. The reporting facility is to report the CO_2 emissions from the combustion of biomass fuels, but these are not included in the emission totals for the facility. The reporter is to record these emissions separately in the EDR application (as a memo item only). For the CH_4 and N_2O emissions resulting from the combustion of biomass fuels, the reporter is to *include* these emissions in the facility totals.

Similarly, for waste incineration processes that may be occurring at the facility, the waste stream may be composed of organic (or biomass) materials and fossil fuel-based carbon materials (e.g. plastics, rubber, liquid solvents, waste oil).

The CO_2 emissions from the biomass portion being incinerated are to be reported separately in the GHG report as a memo item (not included in the CO_2 emission totals), whereas the CO_2 emissions resulting from incineration of the fossil fuel-based fraction are included in the facility totals.

(ii) CO_2 Emissions from Non-combustion of Biomass

Waste disposal can produce substantial amounts of CO_2, a result of aerobic decomposition of organic (or biomass) material in the waste stream. The reporter is not required to report these CO_2 emissions.

4.3 Hydrofluorocarbon, Perfluorocarbon and Sulphur Hexafluoride Emissions

The reporting facility also needs to calculate and report its direct emissions of the HFC and PFC gas species listed in Table 1 and the gas SF_6, if the facility emits these GHGs. The following subsections provide an overview of these GHGs and possible sources of such emissions.

4.3.1 Hydrofluorocarbons

(i) Overview

HFCs are a series of synthetic gases containing carbon, hydrogen and fluorine (see Table 1 for the individual HFC species). While HFCs are emitted in small quantities, they have disproportionate effects as a result of long atmospheric lifetimes, which in turn lead to large GWPs. The HFC species have 100-year GWPs ranging from 140 to as high as 11 700. The use of HFCs is expected to grow substantially as a result of the phasing out of various ozone-depleting substances (IPCC/OECD/IEA, 1997). Applications of these compounds include refrigeration and air conditioning, fire suppression, aerosols, etc. (IPCC/OECD/IEA, 1997). HFCs are not included under the Montreal Protocol because they are not considered to be ozone-depleting substances.

Emissions of HFCs may occur through unintentional leaks or operating losses from various systems. In some applications where they are used, HFCs are released to the atmosphere during maintenance services. It is important to

note that any application may employ an HFC as a pure gas or as a component in a mixture (e.g. HFC-152a is a component of the refrigerant R-500).[15] In such instances, fractions of the HFC-xxx would need to be considered.

(ii) Sources

The manufacture and handling of bulk HFCs serve as emission sources for this group of GHGs. HFCs are also predominantly used in applications where chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and other ozone-depleting substances were once used.[16] The largest area where HFCs serve as replacements for ozone-depleting substances is refrigeration and air-conditioning systems. Emissions occur during the production, use and disposal of such systems. HFC-134a is commonly used by the automotive industry for mobile air conditioning in vehicles (IPCC, 2000). Other end-use applications for HFCs include blowing agents in the production of various foams, propellants in aerosols, use in fire extinguishers, use as solvents, etc. (Cheminfo Services Ltd., 2004).

4.3.2 Perfluorocarbons

(i) Overview

PFCs are a family of industrial gases, and they are to be reported by individual PFC gas species (see Table 1). Total emissions of PFCs are relatively low; however, they are potent GHGs, with 100-year GWPs ranging between 6 500 and 9 200. PFCs are not ozone-depleting substances, so they are not included under the Montreal Protocol (IPCC/OECD/IEA, 1997). Uses of the identified species of PFCs include refrigeration and air conditioning, fire suppression and explosion protection, and solvent cleaning (IPCC/OECD/IEA, 1997).

(ii) Sources

Main sources of PFC emissions are attributed to two sectors — aluminium production and semiconductor production. PFC emissions are an undesirable by-product of aluminium production, while PFCs are purchased and used by semiconductor manufacturers for cleaning purposes. PFCs are also being used as replacements for ozone-depleting substances that have been phased out, in applications such as refrigeration and air conditioning, foams, aerosols, solvents and fire extinguishers (Cheminfo Services Ltd., 2004). Similarly to HFCs, some applications use chemical mixtures that have PFCs as a component of the mixture.

4.3.3 Sulphur Hexafluoride

(i) Overview

SF_6 is a synthetic gas with chemical properties that render it relatively inert, which makes it a preferred choice in various industrial applications. It is a particularly potent GHG, with a 100-year GWP of 23 900 and an estimated lifetime of about 3,200 years (IPCC/OECD/IEA, 1997). Various uses of SF_6 serve as emission sources for this GHG, among which the largest global source is its use in electrical equipment (IPCC, 2000).

(ii) Sources

Main sources of SF_6 emissions include SF_6 used as an insulating gas in electrical equipment (e.g. gas-insulated switchgear, circuit breakers), as a cover gas in magnesium smelting and casting and as a cleaning agent in the production of semiconductors. Other applications employing SF_6 include its use as a cover gas for special foundry products in the aluminium industry, as a substitute for ozone-depleting substances in various applications (e.g. fire suppression and explosion protection) and other minor applications (e.g. in leak detectors, in various electronic applications).

15 Material safety data sheets should provide information on the composition of chemical mixtures (e.g. refrigerants, solvents, other agents) that may be used and that contain HFCs.

16 Ozone-depleting substances have been phased out under the Montreal Protocol.

4.4 Estimation Methods

The reporting facility must identify and report the type of estimation method or methods used to determine the quantities of emissions reported. Such methods could include monitoring or direct measurement, mass balance, emission factors or engineering estimates.

Reporters are reminded of the requirement to keep copies of the information submitted, together with any calculations, measurements and other data on which the information is based.

For Phase 1, there are no specific protocols to define how reporters must calculate their GHG emissions. However, reporters are encouraged to use methods that are consistent with the methodologies approved by the UNFCCC and developed by the IPCC. Refer to sections 2.1–2.4 for background information and a more complete description of the flexibility allotted to reporters in their estimation procedures. If the reporter wishes to obtain further details on the IPCC methodologies, Table 2 presents specific references to the relevant sections of the IPCC Guidelines and the Good Practice Guidance for the emission sources covered.

Table 2: Reference to Methodological Guidance in the IPCC Guidelines and Good Practice Guidance, by Emission Source[17]

Emission Source Category	IPCC Guidelines – Reference Manual (Volume 3)	Good Practice Guidance
CO_2, CH_4, N_2O		
Stationary Combustion	Energy chapter (Chapter 1), pages 1.1–1.62	Energy chapter (Chapter 2), pages 2.1–2.43
Industrial Process	Industrial Process chapter (Chapter 2), pages 2.1–2.42	Industrial Process chapter (Chapter 3), pages 3.1–3.38
Fugitive	Energy chapter (Chapter 1), pages 1.99–1.131	Energy chapter (Chapter 2), pages 2.70–2.93
Other - Waste	Waste chapter (Chapter 6), pages 6.1–6.29	Waste chapter (Chapter 5), pages 5.1–5.31
- Transportation	Energy chapter (Chapter 1), pages 1.62–1.91	Energy chapter (Chapter 2), pages 2.44–2.50
HFCs, PFCs, SF_6		
HFCs	Industrial Process chapter (Chapter 2), pages 2.1–2.3, 2.42–2.62	Industrial Process chapter (Chapter 3), pages 3.69–3.130
PFCs	Industrial Process chapter (Chapter 2), pages 2.1–2.3, 2.34–2.37, 2.42–2.62	Industrial Process chapter (Chapter 3), pages 3.39–3.47, 3.69–3.130
SF_6	Industrial Process chapter (Chapter 2), pages 2.38–2.39, 2.60–2.63	Industrial Process chapter (Chapter 3), pages 3.48–3.78

17 The IPCC Guidelines and Good Practice Guidance documents are available on-line at the following link: http://www.ipcc-nggip.iges.or.jp/public/public.htm.

APPENDIX: REFERENCES

Cheminfo Services Ltd. (2004), *International Management Instruments Regarding HFCs, PFCs and SF_6*, Unpublished report prepared for Environment Canada, March.

IPCC (Intergovernmental Panel on Climate Change) (1996), *1995 Summary for Policy Makers — A Report of Working Group 1 of the Intergovernmental Panel on Climate Change*.

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Olsen, K., Wellisch, M., Boileau, P., Blain, D., Ha, C., Henderson, L., Liang, C., McCarthy, J. and McKibbon, S. (2003), *Canada's Greenhouse Gas Inventory, 1990–2001*, Environment Canada, August.

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