Protocol
2F4: HFC EMISSIONS FROM AEROSOLS

IPCC Category:	2F4
NFR Code:	n.a.
NOSE Code:	n.a.
NACE Code	2011

FOREWORD
Under the Kyoto Protocol, the Netherlands is required to set up and maintain a national system to monitor its greenhouse gas emissions. One of the elements of this system is a transparent and verifiable description of the methods and processes used in this monitoring system. These methods must meet international guideline criteria, which have been defined by the United Nations (UN) and the European Union (EU).

The Netherlands meets the aforementioned requirement, for example, by defining a series of Monitoring Protocols, which describe the methods and work processes used to determine greenhouse gas emissions and the amounts of carbon sinks available. Protocols have been written for about 40 greenhouse gas sources or sinks. This document describes the protocol for one of these sources or sinks.

The protocols have been compiled in close collaboration with experts from various sectors of society in the Netherlands, particularly experts from the Emissions Registration (ER). The ER is a collaborative group that includes institutions such as CBS, WUR, RIVM and PBL. Until 31 December 2009 this was coordinated by PBL (Planbureau for the Leefomgeving, or the Netherlands Environmental Assessment Agency), but on 1 January 2010 this coordination task was taken over by RIVM (the Netherlands institute for public health and the environment). Other institutions that have contributed to the protocols include NL Agency; Ministry of Agriculture, Nature and Food Quality; and the Ministry of VROM (Housing, Spatial Planning and the Environment).

1. 1 SCOPE AND SIGNIFICANCE OF EMISSION SOURCES/ACTIVITIES

1.1 Scope and definition
This protocol describes the method and working processes used to determine HFC (hydro-fluorocarbon) emissions from aerosols, during the production and usage phases (IPCC category 2F4). This concerns the SBI (industrial) code 2011 (the manufacture of industrial gases).

There are 12 companies manufacturing aerosols in the Netherlands. The NAV (Dutch aerosol association) represents 90% of the country's aerosol industry. Most manufacturers use propane and dimethylether (DME) as propellant, although three companies use HDC134a in their products. However, these three companies are small and supply less than 10% of the total Netherlands aerosol production. Of the total number of aerosols produced, only 1% contain HFC134a as propellant. One of the manufacturers also uses very small amounts of HFC152a as propellant, which has a much lower GWP (global warming potential). The GWP for HFC134a is 1300, while that of HFC152a is only 140. Confidentiality considerations mean that it is not possible to report HFC152a usage in the Handelsstromenonderzoek (trade flow study). However, in order to gain better insight into HFC usage and emissions from this

source for the ER (Emissions Registration), the use of HFC152a has been mathematically converted to that of HFC134a, thus maintaining confidentiality.

HFCs are used in aerosols as a propellant. These are split into PUR-foam (polythene) in spray cans (OCF: one component foam) and technical aerosols. OCF is also used in the construction sector as a sealant. Technical aerosols include those used for the following applications:

- Metered dose inhalers (MDI) for asthma patients (no production in the Netherlands).
- High-pressure cleaners for computers and other electronic equipment.
- Freezer sprays for repairing water pipes and testing electronic circuits.
- Specialist lubricant and cleaning agents, e.g. to prevent static electricity.
- Specialist insecticides, e.g. to disinfect aeroplanes.
- Alarm sirens for small boats and personal safety alarms.
- Products that must meet certain safety and health regulations and that may not contain flammable propellants, e.g. paint and party products.

Emissions occur immediately whenever the aerosols are used.

1.2 Significance and influences

1.2.1 Contribution to total national emissions

The HFC emissions from aerosols during the production and usage phases contribute less than 0.1% to the total annual greenhouse gas emissions from the Netherlands.

1.2.2 Developments that infuence emissions

Alternatives for HFK134a in OCF include propane, butane, DME and HFC152a (with its lower GWP, see Section 1.1). Over the past few years most manufacturers in the Netherlands have largely switched to using propane/butane in their products.

Alternatives for HFK134a in the technical aerosols include propane, butane, DME and HFC152a. These gases are actually flammable, although for the applications in which HFCs are allowed, non-flammable propellants should be used.

2 METHOD, EMISSION FACTORS AND ACTIVITY DATA

2.1 Calculation method

HFC emissions from aerosols are determined using the following formula:

> HFC emissions in year t = [(Amount in products sold in year t) x 50%] + [(Amount in products sold in year t-1) x 50%]

This formula should be used for each individual chemical substance. In addition to HFC134a, this subsector uses very small amounts of HFC152a.

The aforementioned method conforms to the calculation method required for HFC emissions from aerosols (tier 2), as described in the IPCC GPG (Good Practice Guidance) § 3.7.1, box 4 (IPCC, 2001, p. 3.84 onwards). Information is included from manufacturers, traders and several large HFC users (see also under Section 2.3 of this protocol).

2.2 Emission factors

Emissions occur every time an aerosol is used. It is assumed that aerosols are used within two years after production, whereby 50% of the propellant is emitted in the first year and 50% in the second year. This 50% conforms to the default value used in the IPCC Good Practice Guidance (IPCC, GPG, 2001).

2.3 Activity data

The extent of HFC usage in aerosols is defined annually via the project 'Use of HCFCs, HFC, and related substances in the Netherlands' (also known as the 'Handelsstromen-onderzoek' or trade flow study). This study was implemented by KPMG (consultants) for the years 1996-2003 (KPMG, 2002 and 2003), and by PWC (Price Waterhouse Coopers) for the year 2004 (PWC, 2004). Usage is determined via surveys completed by manufacturers, traders and several large HFC users. The stock of HFCs in OCF used in the construction industry is calculated based on trade flow study information from previous years. Differentiation between PUR-foam and technical aerosols only began in the year 2000.

3 WORKING PROCESSES

Process for estimating (t-1)

If preliminary figures are required at any point, the following process is used to estimate the figure for t-1. The preliminary data for the work package leader are calculated by extrapolating them from the previous years' figures, based on prognoses for the developments in the most important activity data (taken from CBS (Statistics Netherlands) or other statistical sources).

INPUT	PROCESS	OUTPUT	BY WHOM
Preliminary data work package leader (t-1)	Include t-1 data in ER database	ER-db with (t-1) data	Work package leader
ER-db with (t-1) data	Check emission figures: compare with previous years (trend), modify if required and document everything	ER-db (t-1) with any modified figures	Task force

Process for final determination of (t-2)

The final emission figures (as described in this protocol) are calculated using the following process.

INPUT	PROCESS STEP	OUTPUT	BY WHOM
Annual HFC usage figures for the aerosol sector (currently taken from annual trade flow study)	Check usage figures: - Compare with previous years - Look at the trend If unsubstantiated deviations found, contact the company submitting the annual report → modify the usage figures as required and document fully	Approved usage figures	Work package leader
Approved usage figures. Most recent Emission Factors (EFs), leakage percentages etc. from studies/literature (both national and international)	Enter into (EXCEL) model 'Calculating F-gas emissions'	Detailed and aggregated emissions (=Final data Work package leader (t-2))	Work package leader

INPUT	PROCESS STEP	OUTPUT	BY WHOM
Final data Work package leader (t-2)	Include (t-2) data in ER database	ER-db with (t-2) data	Work package leader
ER-db with (t-2) data	Check, and trend analysis of air emissions: explain deviations or modify figures	Final defined emission figures (t-2)	Task forces and PBL experts

4 UNCERTAINTY AND QUALITY

4.1 Estimating uncertainties

A Tier-1 uncertainty analysis is implemented every year before the NIR is submitted by the ER, based on the greenhouse gas inventory and in compliance with IPCC guidelines. The assumptions used and the results thereof are described in a background report to the NIR. In addition to this, where included in the QA/QC programme for the relevant period, extra analyses are implemented regularly in specific situations, which include any updating of the Tier-2 uncertainty analyses.

The Tier-2 uncertainty assessment was last updated in 2006. This assessment showed that a Tier-1 uncertainty assessment is sufficiently reliable and that Tier-2 uncertainty assessments need only be implemented at periodic intervals of around 5 years, unless a major change in an important source is sufficient to require earlier reassessment.

- Source-specific uncertainty

The uncertainty estimate-totaal concerns the root of the sum of uncertainty in the data sources used (AD_{onz}) in the square and the uncertainty of the emission factor (EF_{onz}) in the square. The extent of the total uncertainty is here primarily determined by the greatest AD or EF uncertainty.

$$\text{Uncertainty estimate}_{\text{total}} = \sqrt{EF_{onz.}^{2} + AD_{onz.}^{2}}$$

The uncertainty estimates concerning the data sources (AD) and emission factors (EF) used, and the total uncertainty estimate, are listed in the following table.

IPCC	Category	Gas	$AD_{onz.}$	$EF_{onz.}$	Uncertainty estimates $_{tot}$
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	10	50	51

The uncertainty in HFC emissions from HFC consumption was estimated to be 51%. The uncertainty in the activity data for the HFC sources was estimated at 10%. For the emission factor, the uncertaintie was estimated at 50%. All of these figure s were based on expert judgements [Olivier et al, 2009].

4.2 Quality assurance and quality control (QA/QC)

The ER work package leaders check that:

1. the basic data are well documented and adopted (check for typing errors, use of the correct unit sizes and correct conversion);
2. the calculations have been implemented correctly;
3. assumptions are consistent, also whether specific parameters (e.g. activity data) are used consistently;

4. complete and consistent data sets have been supplied.

Any actions that result from these checks are noted on an 'action list'. Before defining the data, supervisors check whether the relevant actions on this list, plus the QC checks, have all been completed. Defining the data is carried out by the WEM (working group on emissions monitoring), and confirmed in writing via an e-mail from the institute representatives to the ER project leader at PBL.

The work package leaders fill out a new documentation sheet when adding new data. For reasons of efficiency a minimum level has been set for obligatory documentation, i.e. 5% changes at target group level, and 0.5% at levels concerning the national total. These documentation sheets form part of the trend analysis, as well as the eventual definition of the data set.

The ER work package leaders communicate by e-mail regarding these QC checks, results and actions. They send a printed copy to the ER secretary, who keeps a logbook and compiles these e-mails into an 'action list'. This shows explicitly that the required checks and corrections have been carried out.

4.3 Verification

In order to check the quality of the emission figures for the sources in this protocol, general QA/QC procedures have been followed that are in line with the IPCC guidelines. These are described further in the QAQC programme used by the National System, and the annual working plans published by the ER.

- Sector-specific QC

No additional specific verification procedures are implemented for the sources defined in this protocol.

4.4 Possibilities for improvement compared to the current calculation method

4.4.1 History

Monitoring occurs conform the IPCC Good Practice Guidance, tier 2 method for actual emissions.

4.4.2 Future

When determining the HFC emissions in the Netherlands it is important to use both production and usage figures for the Netherlands situation. Emission calculations are based on the annual trade flow study (see Section 2.3 of this protocol), which indicates the extent to which HFCs are traded for aerosol production in the Netherlands. Some 80% of the total Netherlands aerosol production is exported, but it is not known how many products containing HFCs are imported and exported. Until such time as better information is available, emission calculations assume that the use of aerosols in the Netherlands originate entirely from domestic aerosol production. This means that these calculations do not take account of MDI (metered dosage inhaler) usage in the Netherlands

In order to make these usage figures more accurate, it is important to know the amount of HFCs in aerosol products that are imported and exported. It is recommended that research be conducted in the possibilities if gaining better insight into the extent of import and export trading.

5 REMAINING ASPECTS

5.1 Point source criteria
Not applicable

5.2 Substance profiles
Not applicable

5.3 Regionalisation
Not applicable

5.4 Time-based variations in source strength
Not applicable

6 REFERENCES AND ADDITIONAL INFORMATION

6.1 References

- IPCC, 1997: Revised 1996 IPCC Guidelines for National Greenhouse Gas Emission Inventories, Three volumes: Reference Manual, Reporting Guidelines and Workbook. IPCC/OECD/IEA. IPCC WG1 Technical Support Unit, Hadley Centre, Meteorological Office, Bracknell, UK
- IPCC, 2001: Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, IPCC-TSU NGGIP, Japan
- KPMG, September 2002: *Gebruik van HCFK's, HFK's en aanverwante stoffen in Nederland in 2001 (Use of HCFCs, HFCs and related substances in the Netherlands in 2001).* The Hague, the Netherlands.
- KPMG, September 2003: *Gebruik van HCFK's, HFK's, Methylbromide en aanverwante stoffen in Nederland in 2002 (Use of HCFCs, HFCs, Methylbromide and related substances in the Netherlands in 2002).* The Hague, the Netherlands.
- Olivier J.G.J., L.J. Brandes and R.A.B. te Molder, 2009 (in print) Uncertainty in the Netherlands' greenhouse gas emissions inventory: Estimate of annual and trend uncertainty for Dutch sources of greenhouse gas emissions using the IPCC Tier 1 approach, PBL-Report 500080013, Bilthoven
- PWC, December 2004: *Handelsstromenonderzoek 2003, Onderzoek naar het gebruik van fluorverbindingen in Nederland (Trade flow study 2003: Study into the use of fluor-based compounds in the Netherlands),* Utrecht, the Netherlands.

6.2 Additional information
Not applicable