Protocol
2F8: SF_6 EMISSIONS DURING PRODUCTION AND USE OF SOUND-INSULATED DOUBLE GLAZING IN THE NETHERLANDS

IPCC Category:	2F8
NFR Code:	n.a.
NOSE Code:	n.a.
NACE Code 2008	231

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 SCOPE AND SIGNIFICANCE OF EMISSION SOURCES/ACTIVITIES

1.1 Scope and definition

This protocol describes the methodology and working processes used to determine the SF_6 emission figure for the production, use and end-of-lifespan activities for sound-insulated glazing. These activities concern the SBI (industrial) code 231.

Emissions by the Netherlands as a result of using SF_6 are reported as a single figure under CRF (common reporting format) category 2F8. Such emissions by the high-voltage sector, production of semiconductors, double glazing and electromicroscopes are all aggregated into a single figure and reported under CRF category 2F9 ‘Other’.

The monitoring of SF_6 emissions by the high-voltage sector, production of double glazing, semiconductors and electromicroscopes are all covered in separate protocols.

The contributions from remaining other sources (e.g. the production and use of particle accelerators) are currently not considered substantial (< 0.2 ton SF_6/year, DHV, 2000), and are therefore not included in the determination of total SF_6 emissions.

The Netherlands has 12 manufacturers[1] of sound-insulated glazing that sell products filled with SF_6. This represents 95% of the glass-manufacturing industry in the Netherlands, and 100% of the SF_6-filled glazing. Usage data from all the manufacturers are used as input for the monitoring (see also Section 2.3 and Appendix 2 of this protocol).

The manufacturers in the Netherlands supply around 75-80%[2] of the Dutch market for SF_6-filled glazing; the remaining 20-25% of the demand is met by imported products (mostly from Germany). Import data are also important when calculating emissions from existing stocks of SF_6-filled glazing in the Netherlands (see also Section 2.3 and Appendix 2 of this protocol).

1.2 Significance and influences

1.2.1 Contribution to total national emissions

The total emissions of SF_6 as reported under sector 2F8 (other) contribute less than 0.5% to the total annual greenhouse gas emissions from the Netherlands.

- Aggregated figures due to confidentiality aspects

SF_6 emissions resulting from the high-voltage sector, production of semiconductors, double glazing and electromicroscopes are all aggregated into a single figure and reported under CRF category 2F8 'Other' (UNFCCC, 2004). This is due to the confidentiality aspects of the data. If this information was not aggregated, then production data from the (former) Netherlands high-voltage manufacturer, the test laboratory for high-voltage installations, the semiconductor and electromicroscope manufacturer could all be immediately deduced from the emission figures, activity data and implied emission factors in subcategories 6, 7 and 8 under category 2F.

1.2.2 Developments that infuence emission

At European level, an EU directive is currently being prepared to regulate the use of F-gases, and includes a prohibitory clause concerning the use of SF_6 in sound-insulated double glazing. This new directive is expected to come into force at the beginning of 2006, and the prohibitory clause will be effective two years thereafter.

This has certain consequences for the monitoring of SF_6 emissions with respect to SF_6 use in the manufacture of sound-insulated double glazing, as monitoring will then only focus on emissions during the usage and demolition phases. Once this new directive comes into effect, emissions from the production phase will no longer be monitored.

[1] per 22.02.2002,

[2] This percentage is a best estimate for the sector over the last few years, based on CBS (Statistics Netherlands) data and FIGIN (glass manufacturers' trade association) production figures. Percentages for previous years are not available. This figure is not documented further.

2 METHOD, EMISSION FACTORS AND ACTIVITY DATA

2.1 Calculation method

Since the commencement of this protocol, SF_6 emissions during production and use of sound-insulated double glazing have been calculated using the following formulas:

Emissions during production = 0.33 * Production capacity	[1]
Emissions resulting from leakage in year t = 0.01 * stock of SF_6 in glazing in NL	[2]
Emissions during dismantling phase = amount remaining in glazing * (1-recovery factor)	[3]
Total emissions = sum of [1], [2] and [3]	

Where:

- Emissions: in ton SF_6 in year t
- EF_p : Emission factor during production = 0.33 (per year)
- Production capacity = amount of SF_6 used by the sector (in ton SF_6)
- EF_g : Emission factor during use = 0.01 (per year)
- Stock of SF_6 in glazing within the Netherlands (NL) in year t = B_t (in ton SF_6)
  $= B_{[t-1]} - B_{[t-25]} + C + D$
  $= B_{[t-1]} - B_{[t-25]} + 1.33\ D$
  - $B_{[t-1]}$: existing amount of SF_6 in glazing within NL
  - $B_{[t-25]}$: amount remaining in glazing in dismantling phase year t (lifespan is approx. 25 years)
  - C : import = 0.33 * D
  - D : domestic turnover by NL manufacturers: (1- EF_p) A * 0.96 = 0.67 A * 0.96
    - Annual new domestic turnover by NL manufacturers: 96% (4% export)
- Amount remaining in glazing during dismantling in year t = $B_{[t-25]}$ (lifespan is approx. 25 years)
- Recovery factor: recovery of the gas remaining in the glass at dismantling/demolition phase = 0

The aforementioned method complies with that described by the IPCC in its Good Practice Guidance (GPG, 2001, pp. 3.63-3.66). This concerns a source-specific emission calculation (Box 3), whereby postponed emissions are taken into account. See Sections 2.3 and 2.2 of this protocol for further information on activity data and emission factors.

2.2 Emission factors

Emission factor during production

EF_p : Emission factor during production = 0.33 (per year)

This emission factor is taken from the Good Practice Guidance (IPCC, GPG, 2001, p. 3.65), and concerns an installation-specific emission factor based on experience gained in Germany. The Dutch production method corresponds to that used in Germany.

Emission factor during use

EF_g : Emission factor during use = 0.01 (per year)

It is assumed that around 1% of the gas will leak out each year throughout the lifespan of the glazing. This includes the percentage for breakages. With an average lifespan of 25 years, this means that at the end of the lifespan there will still be around 78% of the original filling in the glass. This emission factor is also taken from the GPG (IPCC, GPG, 2001, p. 3.65) and concerns a country-specific emission factor based on experience gained in Germany. Usage is the same in both the Netherlands and Germany.

Recovery factor
There is currently no method of recovering the gas (recovery factor =0) remaining at the end of the glazing lifespan (demolition).

2.3 Activity data

The datasets required for emission calculations are as follows:

- *Production capacity*: Annual amounts of SF_6 used by the sector (in ton SF_6).
- *Stock in glazing (within the Netherlands)*: annual new turnover in the Netherlands
  $= B_t$ (in ton SF_6)
  $= B_{[t-1]} - B_{[t-25]} + C + D$
  $= B_{[t-1]} - B_{[t-25]} + 1.33\ D$

  - $B_{[t-1]}$: existing amounts of SF_6 in glazing within NL
  - $B_{[t-25]}$: amounts remaining in glazing during demolition in year t (lifespan is approx. 25 years)
  - C : import = 0.33 * D
  - D : domestic turnover by NL manufacturers: $(1- EF_p)\ A * 0.96 = 0.67\ A * 0.96$
    - Annual new domestic turnover by NL manufacturers: 96% (4% export)

  Assumptions:
  - It is assumed that 96% of the aforementioned production capacity focuses on the market in the Netherlands. The other 4% is exported. See Appendix 2.
  - It is also assumed that 25% of the annual stock increase is derived from foreign products (imports, primarily from Germany, see also Section 1.1), which is equal to one-third of the turnover by Dutch manufacturers. See Appendix 2.

- *Stock at demolition*: this is derived from the range of existing glazing stock, taking into account a 25-year lifespan and a remaining gas stock in the glazing of 78%.

Sources:
In January each year the work package leader of the ENINA task force requests double glazing manufacturers to supply the following information, conform their monitoring worksheets (Appendix 2):

- Amount (kg) of SF_6 used during the reporting year.
- Glass production capacity, including the amounts of domestic production compared to exports to other countries.
- Own import of SF_6 double glazing (if applicable) for the Netherlands market.

Individual company statistics concerning SF_6 usage, production capacity, domestic turnover and import of SF_6 are all competitor-sensitive figures and are therefore treated as confidential information. Reviewers/audit team may access this information via the work package leader.

If the aforementioned information is not made available within the time limit, an estimate is made based on previous years.

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 SF_6 used in the double glazing industry and Import figures for double glazing (taken from the trade association for the glazing sector).	Check usage figures: - Compare with previous years - Look at the trend If unsubstantiated deviations are found, contact the supplier of annual use and import figures → if necessary, modify annual use and/or import figures and document fully	Approved annual use and import figure	Work package leader
Approved annual use and import figure. Most recent Emission Factors (EFs) etc. from studies/literature (both national and international)	Enter into 'preliminary' ER work file	Detailed and aggregated emissions for 'preliminary' ER (=Final data Work package leader (t-2)	Work package leader
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

- Aggregated figures due to confidentiality aspects

Emissions of SF_6 from activity data and implied emission factors for SF_6 use in the high-voltage sector, production of semiconductors, double glazing and electromicroscopes are all aggregated into a single figure and reported under CRF category 2F8 'Other' (UNFCCC, 2004). This is due to the confidential nature of the data, otherwise production data for the Netherlands semiconductor and electromicroscope manufacturer (both cases refer to a single plant) could be derived directly from the emission figures, activity data and implied emission factors.

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	SF6 emissions from SF6 use	SF6	50	25	56

The uncertainty in SF_6 emissions from SF_6 consumption was estimated to be about 56%. The uncertainty in the activity data for the SF_6 sources was estimated at 50%. For the SF_6 emission factor, the uncertainties was estimated at 25%. All of these figures 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

Since the year 2000 it has been known, with reasonable certainty, that the Netherlands also uses SF_6 in noise-insulating double glazing. In 2001 the first specific range of SF_6 emission figures for double glazing was determined (from 1990) by the Netherlands Emissions Registration (ER). From this date onwards the figures are also reported in the NIR (National Inventory Report), based on usage figures from 1997-2000. Usage figures by the sector for 1996 and 1996 were also estimated at 1997 levels and, in consultation with the sector, the use of SF_6 is assumed to increase in linear fashion from 1980 (0 usage) to 1995 (4,848 kg SF_6).

4.4.2 Future

The Netherlands is working together with Europe to phase out the use of SF_6 in double glazing. This means that SF_6 emissions in this sector, initially emissions during production, will be reduced to zero (see also Section 1.2.2 of this protocol). A secondary result is that reporting for this source category will cease in this period. Emissions due to leakage and demolition will continue for around 25 years after SF_6 usage in production ceases.

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

- DHV, 2000: Identificatie van onbekende bronnen van overige broeikasgassen (Identification of unknown sources of other greenhouse gases).
- GBO, 2001: Gegevens verbruikte hoeveelheden SF6 voor de productie van dubbelglas, december 2001 (Information on amounts of SF6 used for the production of double glazing, December 2001).
- 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
- Novem: Programma Reductie Overige Broeikasgassen, Verslagen sectoroverleg ROB-dubbelglas (ROB Programme (Reduction Programme non-CO2 greenhouse gases), reports from sector meeting on double glazing).
- 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
- UNFCCC, 2004: Guidelines for the preparation of national communications by Parties included in Annex I to the convention, Part I: UNFCCC reporting guidelines on annual inventories, UNFCCC/SBSTA/2004/8, 3 September 2004

6.2 Additional information

[1] Appendix 1 - datasets and default values
[2] Appendix 2 – worksheet report of company information

APPENDIX 1 - DATASETS AND DEFAULT VALUES

The following table provides an overview of the annual SF *usage* in the double glazing industry in the Netherlands. The trade association collected this information in December 2001.

	1997	1998	1999	2000	2001 (to Oct.)
[kg SF6]	***4,848***	***3,728***	***3,737***	***4,955***	***3,632***

These amounts are based on figures supplied by 12 manufacturers in the Netherlands, which account for 100% of the Dutch production of gas-filled glass (see list). Usage figures for 1995 and 1996 are estimated by the sector based on 1997 levels.

With respect to emissions from existing stock and during dismantling/demolition, figures are also required from 1980 onwards. However, here too, there are no data available. In collective consultations with the sector it is therefore assumed that SF_6 usage has increased in a linear fashion from 1980 (0 use) to 1995 (4,848 kg SF_6).

Companies
1. Glaverbel, including Dupliver in Tiel
2. Rapid Pane, Maasland
3. Rapid Pane, Emmeloord
4. Arvah Glas Zuid in Heerlen & Arvah Glas in Den Bosch
5. Saint Gobain Glass Solutions Technoglas in Veenendaal
6. Frankenglas BV in Weert
7. Ben Evers in Schijndel
8. Smits Isolatieglas in Gemert
9. Scheuten Glas Randstad in Fijnaart-Heiningen
10. Scheuten Glasgroep in Venlo
11. Pels & Joosten in Hoorn
12. Pilkington Benelux in Enschede

APPENDIX 2 – WORKSHEET REPORT (COMPANY INFORMATION)

(Complete one worksheet per manufacturer/production location)

1. General information [to be completed by ENINA task force]

Source category:	SF_6 from sound-insulated double glazing
Target group ER:*	Industry
ER codes:*	RAP code/type; SBI (industrial code) no.
IPCC category:*	Table 2F6 (consumption of HFCs and SF_6 – other sources)
IPCC method:*	
IPCC emission factor:*	
Other emission reports:	
Protocol validity period:	From today to revision
Reporting year:	……

2. Information for emissions monitoring

Manufacturer´s information

Company name	
Location of production unit	
Contact person	
Telephone number	
E/mail address	

Production information

Data	**Value**	**Extra information**
Production [amount of SF_6 used in kg/year]	…….kg SF_6 in reporting year.	

Turnover and import

Data	**Value**	**Extra information**
Portion of the production to be sold in the Netherlands [% of the production, in kg] in the reporting year.	….. % = … …… kg SF_6	
Turnover of company-imported glazing in the Netherlands [kg SF_6]	…… ……kg SF_6	

To be submitted to the ENINA task force before September each year [address of ENINA].