



# Estimation Methodology for Fluorinated Gases

15<sup>th</sup> Workshop on GHG Inventories in Asia (WGIA15)

Session III: Additional Reporting for non-Annex I Parties

12 July 2017

Kiyoto Tanabe

Co-Chair, IPCC Task Force on National Greenhouse Gas Inventories

ipcc

INTERGOVERNMENTAL PANEL ON climate change



# Fluorinated Gases in GHG Inventory

- Under the UNFCCC (Decision 17/CP.8), non-Annex I Parties:
  - should report CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O
  - are encouraged to report HFCs, PFCs, SF<sub>6</sub> and precursors
- On the other hand, Annex I Parties are required (Decision 24/CP.19), as a minimum requirement, to contain information on:
  - CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O
  - PFCs, HFCs, SF<sub>6</sub> and NF<sub>3</sub>
- Inclusion of F-gases is important also for non-Annex I Parties because of:
  - their high global warming potential (GWP);
  - substantial use in industrial processes and in households; and
  - significant opportunities for GHG abatement

# "New" gases in 2006 Guidelines

## - Sources Identified in 2006 Guidelines

By-product & fugitive emissions

	Electronics Industries	Magnesium production	Halogenated Compounds Production	GWP in TAR	GWP in AR4
nitrogen trifluoride (NF <sub>3</sub> )	✓		✓	✓	✓
trifluoromethyl sulphur pentafluoride (SF <sub>5</sub> CF <sub>3</sub> )			✓	✓	✓
halogenated ethers (e.g. C <sub>4</sub> F <sub>9</sub> OC <sub>2</sub> H <sub>5</sub> , CHF <sub>2</sub> OCF <sub>2</sub> OC <sub>2</sub> F <sub>4</sub> OCHF <sub>2</sub> , CHF <sub>2</sub> OCF <sub>2</sub> OCHF <sub>2</sub> )	✓		✓	✓	✓
CF <sub>3</sub> I, CH <sub>2</sub> Br <sub>2</sub> , CHCl <sub>3</sub>			✓	✓	✓
CH <sub>2</sub> Cl <sub>2</sub> , CH <sub>3</sub> Cl			✓	✓	✓
C <sub>3</sub> F <sub>7</sub> C(O)C <sub>2</sub> F <sub>5</sub>		✓	✓		
C <sub>4</sub> F <sub>6</sub> , C <sub>5</sub> F <sub>8</sub> , c-C <sub>4</sub> F <sub>8</sub> O	✓		✓		

## 2 Industrial Processes and Product Use <sup>(Note 1, 2)</sup>

CO<sub>2</sub>

CH<sub>4</sub>

N<sub>2</sub>O

HFCs

PFCs

SF<sub>6</sub>

Other  
halo-  
genated  
Gases  
<sup>(Note3)</sup>

### 2A Mineral Industry

2A1: Cement Production

X

\*

2A2: Lime Production

X

\*

2A3: Glass Production

X

\*

2A4: Other Process Uses of Carbonates

2A4a: Ceramics

X

\*

2A4b: Other Uses of Soda Ash

X

\*

2A4c: Non Metallurgical Magnesia Production

X

\*

2A4d: Other

X

\*

2A5: Other

X

\*

\*

### 2B Chemical Industry

2B1: Ammonia Production

X

\*

\*

2B2: Nitric Acid Production

\*

\*

X

2B3: Adipic Acid Production

\*

\*

X

2B4: Caprolactam, Glyoxal and Glyoxylic Acid Production

\*

\*

X

2B5: Carbide Production

X

X

\*

2B6: Titanium Dioxide Production

X

\*

\*

2B7: Soda Ash Production

X

\*

\*

2B8: Petrochemical and Carbon Black Production

X

X

\*

2B8a: Methanol

X

X

\*

2B8b: Ethylene

X

X

\*

2B8c: Ethylene Dichloride and Vinyl Chloride Monomer

X

X

\*

2B8d: Ethylene Oxide

X

X

\*

2B8e: Acrylonitrile

X

X

\*

2B8f: Carbon Black

X

X

\*

2B9: Fluorochemical Production <sup>(Note 4)</sup>

2B9a: By-product Emissions <sup>(Note 5)</sup>

2B9b: Fugitive Emissions <sup>(Note 5)</sup>

2B10: Other

\*

\*

\*

\*

\*

\*

\*

Emissions from  
manufacturing  
processes in  
industries

## 2 Industrial Processes and Product Use <sup>(Note 1, 2)</sup>

CO<sub>2</sub>CH<sub>4</sub>N<sub>2</sub>O

HFCs

PFCs

SF<sub>6</sub>Other  
halo-  
genated  
Gases  
<sup>(Note 3)</sup>

### 2C Metal Industry

2C1: Iron and Steel Production

X

X

\*

2C2: Ferroalloys Production

X

X

\*

2C3: Aluminium Production

X

\*

X

2C4: Magnesium Production <sup>(Note 6)</sup>

X

X

X

X

2C5: Lead Production

X

2C6: Zinc Production

X

2C7: Other

\*

### 2D Non-Energy Products from Fuels and Solvent Use <sup>(Note 7)</sup>

2D1: Lubricant Use

2D2: Paraffin Wax Use

2D3: Solvent Use <sup>(Note 8)</sup>2D4: Other <sup>(Note 9)</sup>

\*

\*

\*

### 2E Electronics Industry

2E1: Integrated Circuit or Semiconductor <sup>(Note 10)</sup>

\*

\*

X

X

X

X

2E2: TFT Flat Panel Display <sup>(Note 10)</sup>

X

X

X

X

2E3: Photovoltaics <sup>(Note 10)</sup>

X

X

X

X

2E4: Heat Transfer Fluid <sup>(Note 11)</sup>

X

2E5: Other

\*

\*

\*

\*

\*

\*

\*

Emissions from  
manufacturing  
processes in  
industries

Emissions from  
manufacturing  
processes in  
industries

## 2 Industrial Processes and Product Use <sup>(Note 1, 2)</sup>

CO<sub>2</sub>CH<sub>4</sub>N<sub>2</sub>O

HFCs

PFCs

SF<sub>6</sub>Other  
halo-  
genated  
Gases  
<sup>(Note 3)</sup>

### 2F Product Uses as Substitutes for Ozone Depleting Substances

2F1: Refrigeration and Air Conditioning

2F1a: Refrigeration and Stationary Air Conditioning

2F1b: Mobile Air Conditioning

2F2: Foam Blowing Agents

2F3: Fire Protection

2F4: Aerosols

2F5: Solvents <sup>(Note 12)</sup>

2F6: Other Applications

### 2G Other Product Manufacture and Use

2G1: Electrical Equipment

2G1a: Manufacture of Electrical Equipment <sup>(Note 13)</sup>2G1b: Use of Electrical Equipment <sup>(Note 13)</sup>2G1c: Disposal of Electrical Equipment <sup>(Note 13)</sup>2G2: SF<sub>6</sub> and PFCs from Other Product Uses

2G2a: Military Applications

2G2b: Accelerators <sup>(Note 14)</sup>

2G2c: Other

2G3: N<sub>2</sub>O from Product Uses

2G3a: Medical Applications

2G3b: Propellant for Pressure a

2G3c: Other

2G4: Other

### 2H Other

2H1: Pulp and Paper Industry

2H2: Food and Beverages Ind

2H3: Other

Leakage of F-gases used in products or applications

Leakage of F-gases used in products or applications (manufacture of electrical equipment is included)

# Emissions from Manufacturing Industries

- Fluorochemical Production (Category 2B9, Chapter 3.10 in Vol.3)
  - By-product emissions and fugitive emissions
  - Major one is HFC-23 emissions from HCFC-22 production
  - Simple Tier 1 method and default EFs are provided
- Aluminium Production (Category 2C3, Chapter 4.4 in Vol.3)
  - Emissions of  $\text{CF}_4$  and  $\text{C}_2\text{F}_6$  during anode effects (primary production)
  - Simple Tier 1 method and default EFs are provided by cell technology type
- Magnesium Production (Category 2C4, Chapter 4.5 in Vol.3)
  - Emissions of  $\text{SF}_6$ , HFCs, etc from magnesium casting processes
  - For  $\text{SF}_6$ , Simple Tier 1 method and default EFs are provided
  - For other gases (e.g. HFCs), Tier 1 method is NOT provided because of lack of sufficient data in 2006
- Electronics Industry (Category 2E, Chapter 6 in Vol.3)
  - Emissions of HFCs, PFCs,  $\text{SF}_6$ ,  $\text{NF}_3$ , etc from production of semiconductors, TFT flat panel displays, photovoltaics, etc
  - For  $\text{CF}_4$ ,  $\text{C}_2\text{F}_6$ ,  $\text{CHF}_3$ ,  $\text{C}_3\text{F}_8$ ,  $\text{NF}_3$ ,  $\text{SF}_6$ ,  $\text{C}_6\text{F}_{14}$ , Simple Tier 1 method and default EFs are provided

# Emissions from Product Use

- Emissions of Fluorinated Substitutes for ODS (Category 2F, Chapter 7 in Vol.3)
  - Leakage of F-gases contained in various products/applications that are used not only in industries but also in households, such as:
    - ✓ refrigeration and air conditioning
    - ✓ fire suppression and explosion protection
    - ✓ aerosols
    - ✓ solvent cleaning
    - ✓ foam blowing
    - ✓ other applications
  - Method is explained later in this presentation
- Other Product Manufacture and Use (Category 2G, Chapter 8 in Vol.3)
  - Emissions of SF<sub>6</sub> and PFCs from
    - ✓ manufacture and use of electrical equipment
    - ✓ a number of other products
  - Simple Tier 1 method and default EFs are provided

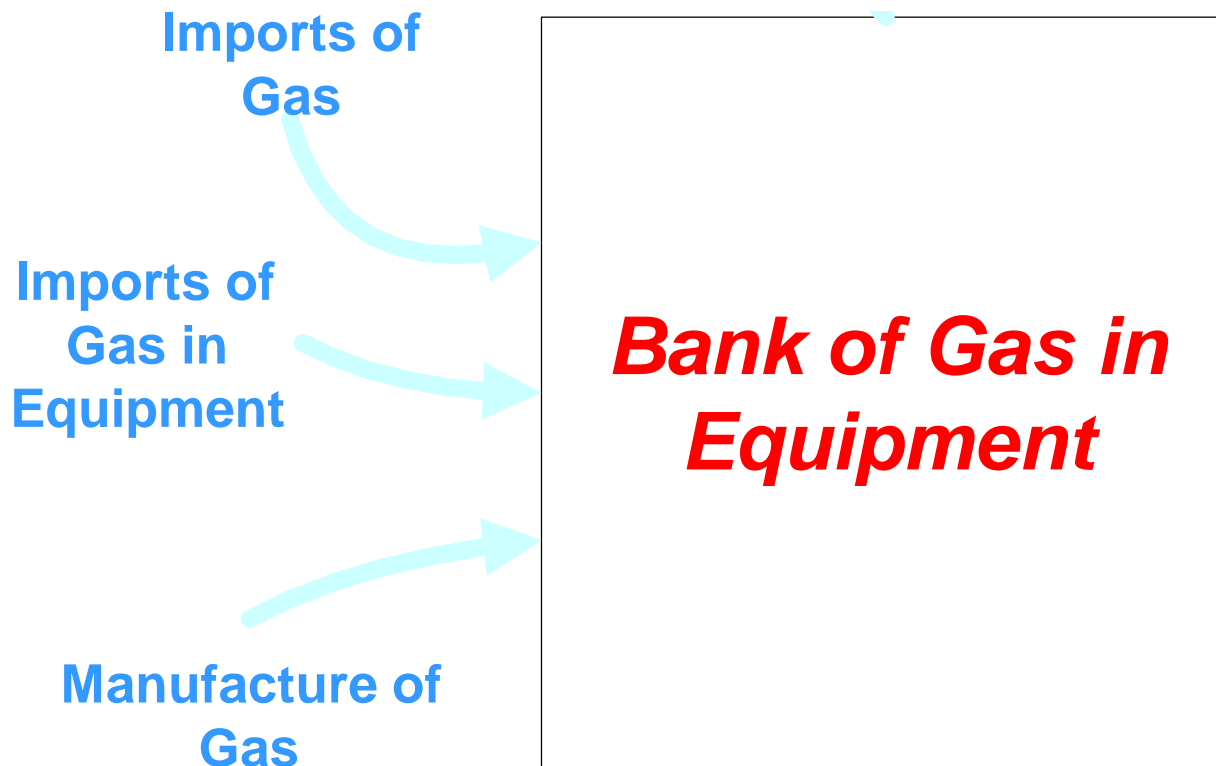


# 2F: Fluorinated Substitutes for ODS

- *Applications or Sub-applications* - major groupings of current and expected usage of the ODS substitutes
- *Actual emissions vs. Potential emissions* (2006 vs.1996)
- *Prompt emissions* (within 2 years) and *Delayed emissions*
- *Bank* – total amount of substances contained in existing equipment, chemical stockpiles, foams, other products not yet released to the atmosphere (+ExIm)
- **Approaches:**
  - Emission Factor (a) and Mass-balance (b)
  - Tier 1 and Tier 2

# “Bank”

Total amount of substances contained in existing equipment, chemical stockpiles, foams and other products not yet released to the atmosphere



# Actual emissions vs. Potential emissions

- The *2006 IPCC Guidelines* provide with methods for estimating actual emissions of ODS substitutes in contrast to potential emissions approach (*1996 IPCC Guidelines*) taking into account the time lag between consumption of ODS substitutes and emissions.
- Potential emissions approach assumes that all emissions from an activity occur in the current year (*manufacture + import - export - destruction*), *ignoring the fact they will occur over many years, thus estimates may become very inaccurate*
- Use of actual emissions allows to:
  - accurately estimate emissions of ODS substitutes
  - proper address emission reductions of abatement techniques

# Difficulties

➤ However, estimation of actual emissions is not as easy as potential emissions, because it has to take the “bank” into account, which requires:

- ✓ Complex calculation as compared to very simple equation for potential emission estimates

Can we overcome this?

$$Emissions_t = Bank_t \bullet EF + RRL_t$$

and

$$Bank_t = \sum_{i=t_0}^t (Production_i + Imports_i - Exports_i - Destruction_i - Emissions_{i-1}) - RRL_t$$

- ✓ Data for many years in the past on production, exports, imports, etc of chemicals (cf., potential emission estimates require only the current year data)

Can we overcome this?

ipcc

INTERGOVERNMENTAL PANEL ON climate change



# Yes, we can!!

➤ New IPCC software enables you to estimate actual emissions even if you do not have data for many years in the past – if you have at least the data/information on:

- Year of introduction of agent
- Domestic production of agent in current year
- Imports of agent in current year
- Exports of agent in current year
- Growth rate of sales of equipment that uses the agent

✓ For example, in the case the data are available only for 2005 and 2010 while you know the chemical has been used since 1995...

(tonne)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Produced Quantity											26091					27925
Exported Quantity											18046					23963
Imported Quantity											9287					17222

Data will be automatically estimated using an empirical assumption.

Data will be automatically estimated using interpolation.

# Confidentiality

- Data providers might restrict access to information because it is confidential, unpublished, or not yet finalized
  
- Find solutions to overcome their concerns by:
  - explaining the intended use of the data
  - agreeing, in writing, to the level at which it will be made public
  - identifying the increased accuracy that can be gained through its use in inventories
  - offering cooperation to derive a mutually acceptable data sets
  - and/or giving credit/acknowledgement in the inventory to the data provided



# Thank you

<http://www.ipcc-nggip.iges.or.jp/index.html>

ipcc

INTERGOVERNMENTAL PANEL ON climate change

