



Norwegian Collection of Activity Data and Determination of Leakage Rates and Other Parameters

Torgrim Asphjell, Riga, May 21, 2015



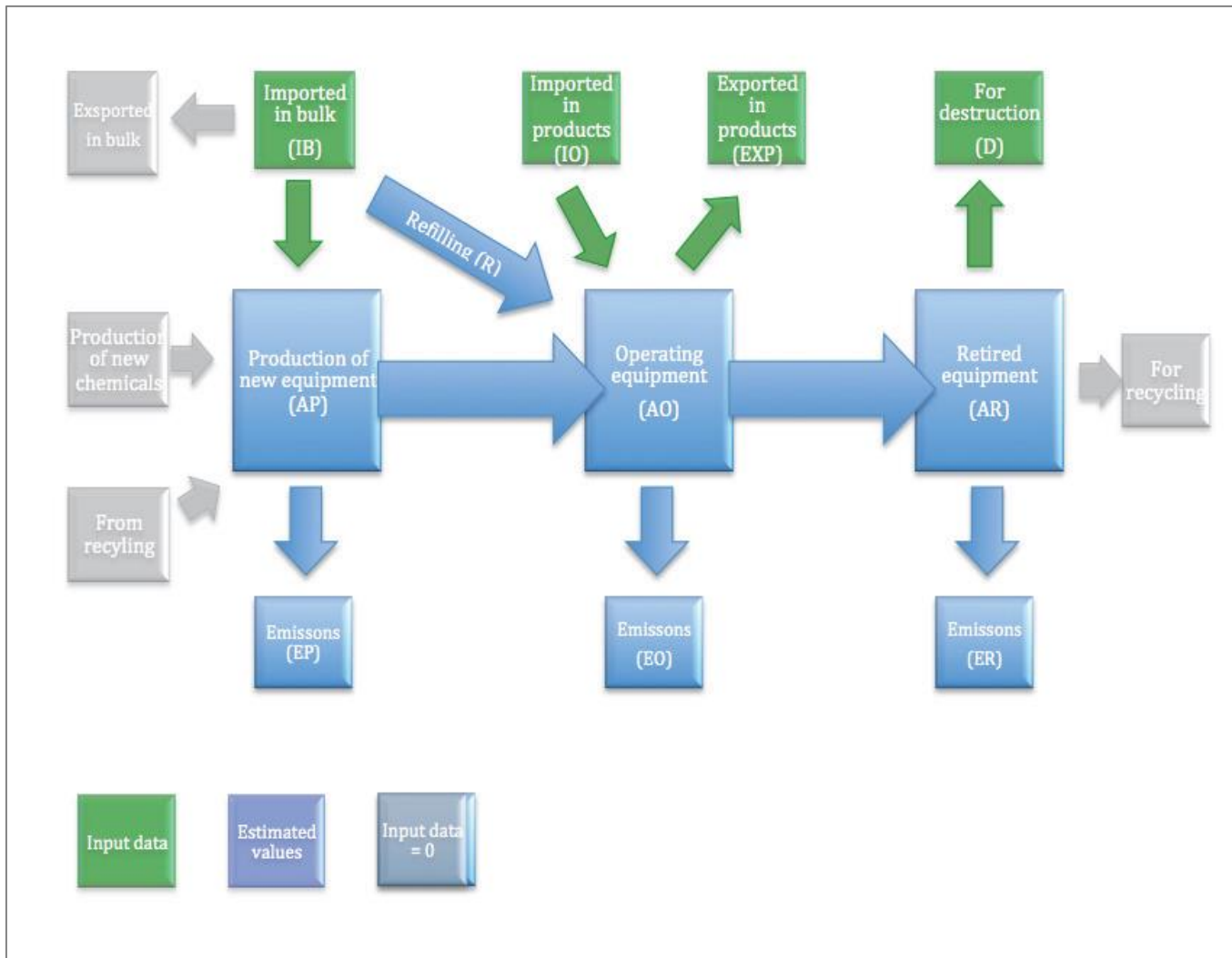
Main Input to the Inventory

(Data relevant for F-gases in Red)

- Consumption of fossil fuels (attained from energy balance)
- **Emission factors (IPCC, Country specific)**
- **Emissions reported from key industrial sites (PFC from aluminium production)**
- Results from additional models, like:
 - Methane from landfills
 - Road traffic model
 - **HFC emissions model (F-gases in products)**
- Results from Land Use Land Use Change and Forestry (LULUCF) model



Phases in a Product's Life Cycle and Flow of Chemicals



Methodology HFC (and PFC) from Products

Yearly input data

Gas in bulk:

Import (Gases, Amount, Use)

Export (Gases, Amount)

Data collected annually from taxation (and refund) statistics

Gas in products:

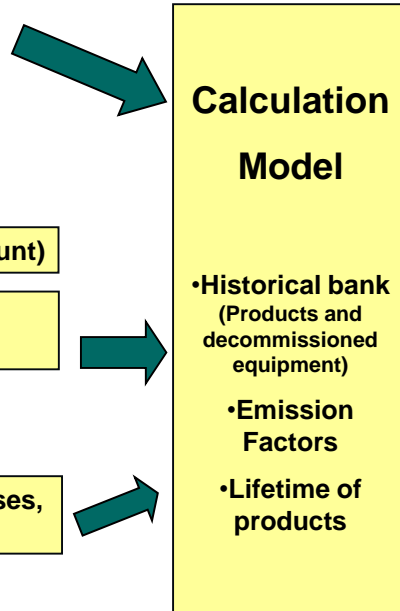
Import (Product Type, Gases, Amount)

Export (Product Type, Gases, Amount)

Data collected annually from taxation and refund data

Gas Collected and Destroyed (Gases, Amount)

Annual data from collection company



Calculated data

Gas not emitted:

Bank in Operating Equipment

Bank in Stocks and Decommissioned Equipment and Products

Destructed Gases

Emissions:

From Operating Equipment

From Decommissioning of Equipment and Products

From Production and Installation

Data Sources

- 2010 onwards:
 - Annual updates of amounts of gas imported, exported, and destructed
 - Import (and export) data from the Norwegian Directorate of Customs and Excise
 - Collection/Destruction data from Stiftelsen Returgass
- 1990-2009:
 - Actual information for some years and interpolation
 - Import and export in bulk reported to Environment Agency from companies
 - Query by Statistics Norway and Environment Agency on consumption and use in products
 - Collected/destructed amounts from Stiftelsen Returgass
- Emission factors and GWP values:
 - IPCC Guidelines and national experts

Data Needs on Flow of HFCs

- Amounts of chemicals flowing in and out of the country and amounts collected and destroyed from retired equipment:
 - Imports of chemicals in bulk
 - Imports of chemicals in products
 - Exports of chemicals in products and bulk
 - Destruction of chemicals

- Needed for each application category and each chemical



Application Categories and National Emission Factors

Table 2.1. Emission factors for HFCs and PFCs

Application category (a)	Leakage rates for production of new equipment (EFP). Per cent of initial charge	Leakage rates for operating equipment (EFO). Per cent of initial charge/year	Lifetime (lt). Years
Refrigeration			
Domestic Refrigeration	Not occurring	0.5	15
Commercial Refrigeration			
Stand-alone Commercial Applications	Not occurring	3.5	10
Medium and Large Commercial Refrigeration	2	10	15
Transport Refrigeration	1	20	9
Industrial Refrigeration	2	10	15
Residential and Commercial A/C, including heat pumps	1	4	15
Mobile Air-Conditioning	Not occurring	Not applicable ²	12
Foam			
Hard Foam	5	4.5	20
Soft Foam	Not occurring	Not occurring	Not occurring
Fire protection			
	2 ¹	5	15
Aerosols			
Metered Dose Inhalers	Not occurring	50	2
Other aerosols	Not occurring	50	2
Solvents			
	Not occurring	50	2

¹Country specific, see Haukås et al. (1999).

²A mass balance approach is used to estimate emissions from mobile air conditioning. See section 2.2.2.

Estimation of Bank

New Bank

= Bank last year

+ Bank in produced/installed equipment current year

- Export

- Decomissioning

- Emissions last year

+ Refilling

Emissions from Equipment in Use (General)

Non-refillable equipment:

Emissions = Bank x Emission factor

Refillable equipment:

Emissions = Bank x Emission Factor

Or

Emissions = Refill

Amount of Gas in Retired Equipment

Refillable Equipment:

Amount = Initial filling

Non-refillable equipment:

Amount = Initial filling - leakage during lifetime

Inhalators, Soft Foam o.a:

Amount = Zero



Example: Medium and Large Commercial Refrigeration

Input data:

- Import of gases in bulk
- Import and export of products with gas
- Information on sector from commodity codes, company info and expert judgement
- Data on gas collected and destroyed
- Leakage rates during use
- Leakage rates during production / installation
- Lifetimes

Calculated data:

- Emissions from operating equipment calculated from bank and leakage rates (10%)
- Emissions from production and installation of new equipment calculated from total bulk import minus emissions from operating equipment.
- Emissions from decommissioning calculated from lifetime and data on gas collected and destroyed



Example: Mobile Air - Conditioning

Input data:

- Import of vehicles with air-conditioning, combined with data on gas amount per vehicle (taxation import data)
- Import of HFC-134a in bulk from companies importing for vehicle sector
- (Export of cars with air-conditioning)
- HFC-134a from scrapped vehicles collected and destroyed
- Leakage rates during use
- Lifetimes

Calculated data:

- Emissions from cars in use calculated from either bulk import or by bank * emission factor (if exceeding bulk import)
- Decommissioning emissions calculated from lifetime of cars and data on gas collected and destroyed

Example: Residential Heat Pumps

Input data

- Import of Heat Pumps
- Amount of gas per heat pump (incl. gas composition)
- Product life time
- Leakage rate for operating equipment
- Destroyed amounts of gas

Calculated data

- Emissions for operating equipment calculated from amount in operating equipment and leakage rate (4%)
- Emissions from decommissioning calculated from lifetime, emission factor and destroyed amounts

Example: SF₆ From GIS

Tier 3a methodology (IPCC 2000)

Annual reports from major users to SFT since 2003

- Detailed and yearly updated data on installed capacity (bank)
- Detailed and yearly updated data on refilling
- In-use emissions defined as amount of gas used for refilling (caused by regular leakage and, possibly, accidental leakage)
- Compensate for equipment taken out of service
- Separate reporting from producer

Pre 2003 (SFT 1999)

- Activity data (bank size) * EF (1 per cent)
- Bank size estimated by contact with importers, exporters and users



SF6: Default Leakage Rates

Table 5 Yearly rate of leakage of SF6 from different processes

Process emission source	Leakage rate (per cent of input of SF ₆)
Secondary magnesium foundries	100
Tracer gas in the offshore sector	0
Tracer gas in scientific experiments	100
Production of semiconductors	50
Medical use (retinal surgery)	100
Production of sound-insulating windows	2
Other minor sources	100

Source: SFT (1999).

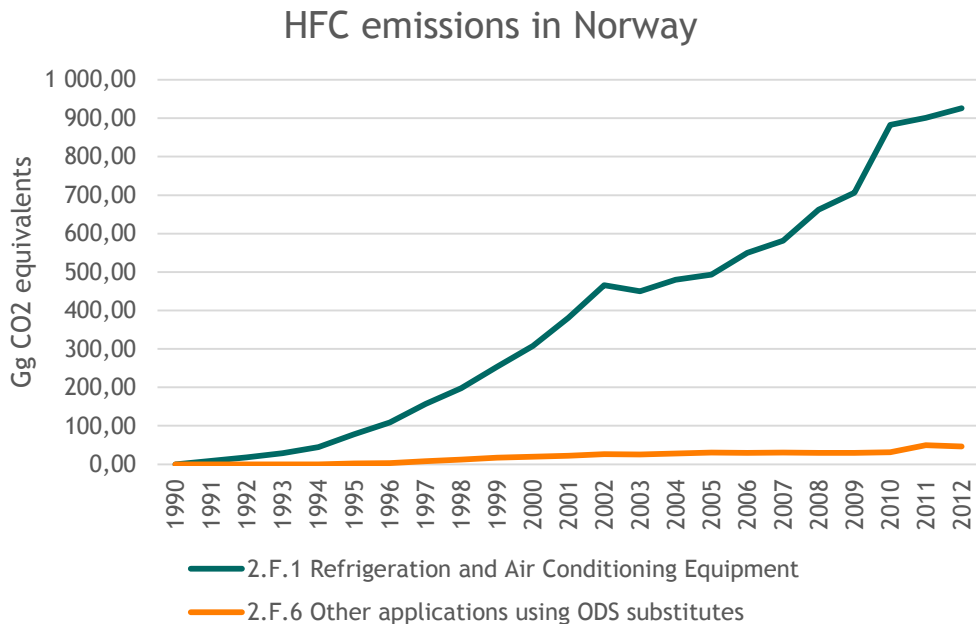
Table 6 Product lifetimes and leakage rates from products containing SF6

Product emission source	Yearly rate of leakage (per cent)	Product lifetime (years)
Gas-insulated switchgear (GIS)	1	30
Sealed medium voltage switchgear	0.1	30
Electrical transformers for measurements	1	30
Sound-insulating windows	1	30
Footwear (trainers)	25	9
Other minor sources

Source: SFT (1999).

HFC Emissions – Norwegian Reporting

- Refrigeration and air conditioning most important emission source
- Due to confidentiality all other emission sources are aggregated to 2F6

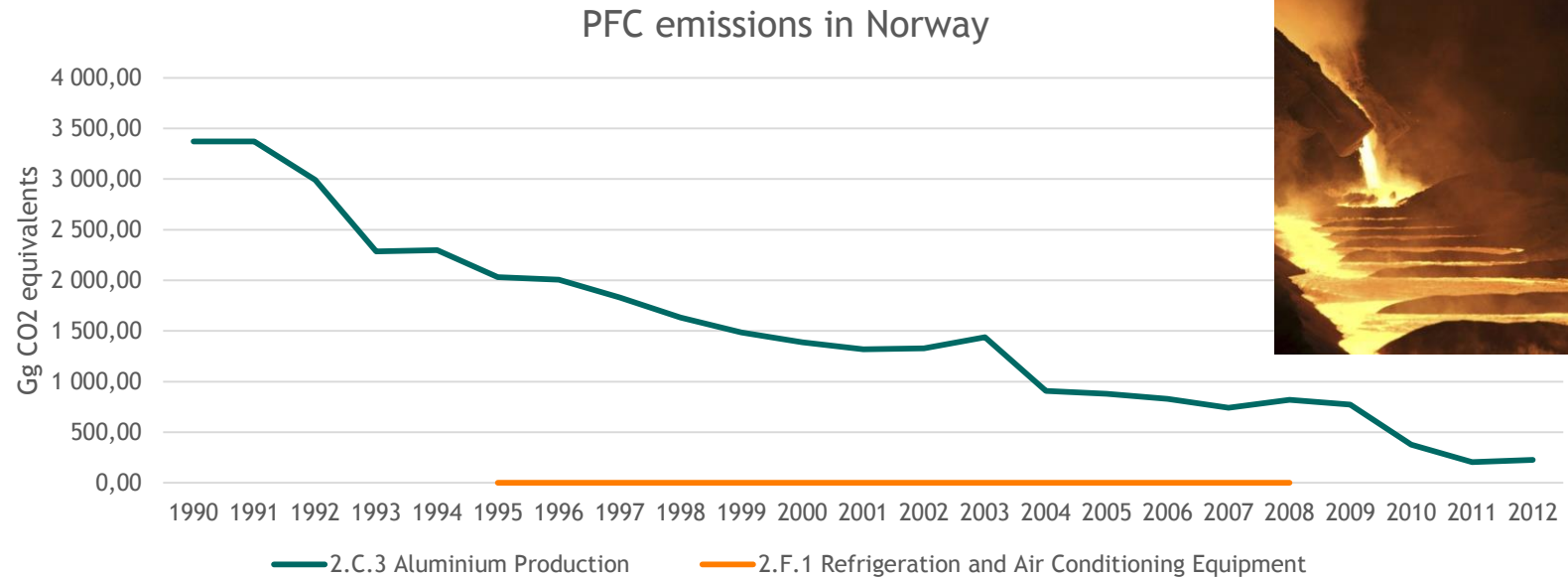


Main Gases

Table 4.1. Emissions of HFCs and PFCs from product use. 1 000 tonnes CO₂-equivalents

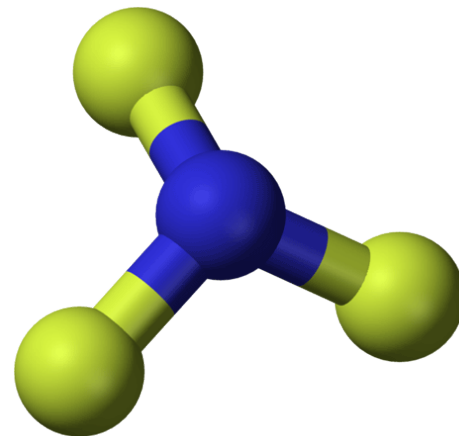
	1990	1995	2000	2005	2010	2011
HFC-23	-	0.1	0.7	1.7	1.3	1.9
HFC-32	-	0.3	1.3	3.9	12.8	14.5
HFC-125	<0.1	14.5	97.4	159.6	263.5	276.7
HFC-134	-	-	-	0.8	1.9	1.8
HFC-134a	<0.1	49.9	117.3	180.9	364.0	397.4
HFC-143	-	-	-	0.3	0.3	0.3
HFC-143a	<0.1	15.4	109.0	169.5	263.0	245.8
HFC-152a	<0.1	0.2	1.1	4.3	5.5	5.6
HFC-227ea	-	-	0.5	2.9	2.0	6.1
PFC-218	-	0.2	0.2	0.1	-	-
Total	<0.1	80.6	327.6	524.2	914.4	950.2

PFC from Aluminium Production



NF₃

- Insignificant manufacture of integrated circuits, semiconductors, and TFT flat panel displays in Norway
- No known emission sources of NF₃ found





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