Twinning Project EE2005/IB/EN/01:

Enhancing the Capacity to Reduce the Emissions of Fluorinated Greenhouse Gases in Estonia

Twinning project between the Estonian Ministry of Environment and the German Ministry of Environment, Nature Conservation and Nuclear Safety

F-gas Inventory Estonia 2006 – Final Report

Contents

PREFACE

This study sums up the result of the first basic investigation on Estonia's consumption of fluorinated greenhouse gases in 2006 (F-gas inventory) within the framework of the Twinning Project EE2005/IB/EN/01 "Enhancing the Capacity to Reduce the Emissions of Fluorinated Greenhouse Gases in Estonia". The empirical investigation started in August 2007 and was finished in July 2008.

Data collecting and assessment of emissions is based on the 1996 and 2006 IPCC Guidelines and the 2006 updated UNFCCC Reporting Guidelines[1], on the experiences laid down in the 2005 Öko-Recherche study for the German Federal Environmental Agency (Umweltbundesamt)[2] and on detailed bottom up field studies within the country of Estonia mostly resulting in country specific assessment of activity data, emission factors (EF) and emissions.

The study was prepared by Dr. André Leisewitz in cooperation with Kristina Kaar and Kristiina Nikkel from the Estonian Environmental Research Centre (Eesti Keskonnauuringute Keskus, Tallinn). Thanks to Ene Kriis, Inari Truuma and Kaidi Toomsalu who took part in the field work.

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts (Dr. W. Schwarz). For the combination of individual uncertainties approach 1 of the 2006 IPCC Guidelines[3] was applied.

First preliminary data has been reported within the 2008 Estonian National Inventory Report (NIR) to the UNFCC secretariat for 2006.[4]

Tallinn, September 2007

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[1] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Reference Manual Vol. 3; 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol 3, Chapter 7 Emissions of Fluorinated Substitutes for Ozone Depleting Substances; UNFCCC, Updated UNFCCC reporting guidelines on annual inventories following incorporation of the previsions of decision 14/CP.11 (FCCC/SBSTA/2006/9), 18 August 2006. The GWP calculation is based on the 1995 IPCC GWP values (100-year time horizon), ibid., p. 15.

[2] W. Schwarz, Emissions, Activity Data, and Emission Factors of Fluorinated Greenhouse Gases (F-Gases) in Germany 1995-2002, Umweltbundesamt Texte 15/05, 2005.

[3] Intergovernmental Panel on Climate Change, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol 1, Chapter 3 Uncertainties: 3.2.3.1.Approach 1 (Multiplication): Propagation of Error.

[4] Greenhouse Gas Emissions in Estonia 1990-2006. National Inventory Report to the UNFCCC secretariat. Common Reporting Formats (CRF) 1990-2006, Tallinn 2008, chapter 3, Industrial Processes (CRF2), 3.5: Consumption of Halocarbons and SF6, p. 83-104; CRF-tables 2(II).E, 2(II)Fs1, 2(II)Fs2.
(http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/4303.php)

INTRODUCTION AND SUMMARY

1. Estonia's F-gas reporting obligations

Estonia signed the Framework Convention on Climate Change at the UN Conference on Environment and Development held in Rio de Janeiro in June 1992. In 1994 the country ratified the UNFCCC (United Nations Framework Convention on Climate Change) and in 2002 the Kyoto Protocol. According to this and the European Council Decision 280/2004/EC Estonia has to submit annually greenhouse gas (GHG) inventory reports to the UNFCCC Secretariat and to the European Commission including the three fluorinated GHG hydrofluorocarbons (HFC), perfluorocarbons (PFC) and sulphur hexafluoride (SF6) – the so called F-gases (Kyoto Protocol Annex A).

The annual reporting to both institutions follows the same methodological UNFCCC and IPCC guidelines. It consists of the National Inventory Report (NIR) and the associated Common Reporting Format (CRF) tables with activity data, emission factors (EF) and emissions.

2. Twinning Project/F-gas Inventory 2006 – setup

As outlined in the Estonian 2007 National Inventory Report[5], the country had so far no database on domestic consumption of F-gases covered by the Kyoto protocol. Hence no empirically based assessment of F-gas emissions and reporting on these GHG was possible.

In the second half of 2007 the Twinning Project EE2005/IB/EN/01 "Enhancing the capacity to reduce the emissions of fluorinated greenhouse gases in Estonia" (Twinning project between the Estonian Ministry of Environment and the German Ministry for the Environment, Nature Conservation and Nuclear Safety) started. Data collecting with the aim to establish the required F-gas inventory (basic evaluation of activity data, emission factors and emissions for 2006) was finished in July, 2008.

The project evaluated about 40 sectors of possible F-gas application in Estonia by direct contacts to importers and trade, users (industry, commercial and services sector), state authorities (e.g. Statistical Office, Car Register, Maritime Authority) and experts from associations and academia. As far as possible the investigation was organized as a complete inventory count (bottom up investigation) combined with expert assessment. The method applied follows IPCC Guidelines 2006: mostly tier 2 with country specific determination of EF.

[5] Greenhouse Gas Emissions in Estonia 1990-2005. National Inventory Report to the UNFCCC secretariat. Common Reporting Formats (CRF) 1990-2005, Tallinn 2007, p. 43.

3. Twinning Project/F-gas Inventory – main results

3.1 Production of Halocarbons and SF6 – CRF table 2(II)E

HFC, PFC and SF6 are not produced in Estonia. By-product emissions and production-related emissions of halocarbons and SF6 do not occur.

3.2 Consumption of Halocarbons and SF6 – CRF table 2(II)F: Sectors without importance in Estonia

The consumption of Halocarbons and SF6 in Estonia depends on import. F-gases are imported either in bulk by trade or industry for domestic productive consumption (manufacturing) – filling of newly manufactured products, refilling of equipment – or in imported preliminary and final products respective equipment already filled with F-gases.

The following sectors of potential F-gas application turned out to be without importance in Estonia:

- 2(II)F5, Solvents
- 2(II)F6, Other applications using ODS substitutes
- 2(II)F8, Particle Accelerators
- 2(II)F9, Soundproof Glazing; Car Tires; Magnesium Casting; Tracer Gas; Aluminium Cleaning; Aircraft Radar; Power Capacitors; Manufacture of Printed Circuit Boards; Semiconductor Manufacturing; Production of Aluminium.

3.3 NIR 2008 – Preliminary data on F-gas consumption

A preliminary report on Estonia's F-gas emissions was given within the 2008 National Inventory Report (NIR).

The preliminary report covered most of the application areas from the CRF-sectors 2(II).F.1c Transport Refrigeration, 2(II).F.1e Stationary Air Conditioning, 2(II).F.1f Mobile Air Conditioning (Ships), 2(II).F.2 Foam Blowing, 2(II).F.4 Aerosols, 2(II).F.7 Electrical Equipment for Transmission of Electricity and 2(II).F.8 Other Electrical Equipment.

The 2006 F-gas emissions preliminary reported in the 2008 NIR submission amounted to 75.18 Gg HFCs and 0.80 Gg SF6, in total 75.98 Gg CO2 equivalent. The F-gas share in the total Estonian GHG emissions of 18876.18 Gg CO2 equivalent (reported in the 2008 NIR) was 0.4%.[6]

[6] Greenhouse Gas Emissions in Estonia 1990-2006. National Inventory Report to the UNFCCC secretariat. Common Reporting Formats (CRF) 1990-2006, Tallinn 2008, p. 14 (Tab. ES2_2).

3.4 Estonia's F-gas emissions according to the F-gas Inventory Estonia 2006 – Final Report

The total of the Estonian F-gas emissions in 2006 as investigated by the finished Twinning project amounts to 141.14 Gg CO2 equivalents (table 1). From these 65.16 Gg CO2 equivalents had not yet been reported in the preliminary F-gas chapter of the 2008 NIR submission.

Tab. 1: F-gas Emissions Estonia 2006 by sectors (metric tons and CO2 equivalents)

CRF-sectors/research subsectors	Type of F-gas	F-gas emissions (metric t)	F-gas emissions (metric t) per sector in %	F-gas emissions CO2-equiv. (t)	F-gas emissions CO2-equiv. (gG)	F-gas emissions CO2-equiv. per sector in %
2(II).F.1 Refrigeration and Air Conditioning Systems	404A, 407C, 410A, 152a	46.32666	52.93	92948.057	92.94806	65.85
2(II).F.1a Domestic Refrigeration	HFC-134a	0.30300	0.35	393.900	0.39390	0.28
2(II).F.1b Commercial Refrigeration	HFC-134a, 404A, 407C, 410A, 152a	7.42804	8.49	22971.522	22.97152	16.28
2(II).F.1c Transport Refrigeration	HFC-134a, 404A	3.92559	4.48	11623.000	11.62300	8.23
1. Refrigerated Vehicles	HFC-134a, 404A	3.52029	4.02	11014.500	11.01450	7.80
2. Reefer Container	HFC-134a, 404A	0.40530	0.46	608.500	0.60850	0.43
2(II).F.1d Industrial Refrigeration	HFC-134a, 402A, 404A, 407C, 152a	5.74978	6.57	18362.195	18.36220	13.01
2(II).F.1e Stationary Air Conditioning	HFC-134a, 407C, 410A	10.24880	11.71	15021.711	15.02171	10.64
1. Heat Pumps	HFC-407C, 410A	0.32620	0.37	532.531	0.53253	0.38
Stationary and Room Air Conditioning	HFC-134a, 407C, 410A	9.92261	11.34	14489.180	14.48918	10.27
2(II).F.1f Mobile Air Conditioning	HFC-134a, 404A, 407C, 152a	18.67145	21.33	24575.729	24.57573	17.41
1. Passenger Cars	HFC-134a	13.08138	14.95	17005.800	17.00580	12.05
2. Trucks	HFC-134a	1.99387	2.28	2592.030	2.59203	1.84
3. Buses	HFC-134a	1.03877	1.19	1350.390	1.35039	0.96
4. Ships	HFC-134a, 404A, 407C	1.49700	1.71	2283.740	2.28374	1.62
5. Railcars	HFC-152a	0.03000	0.03	4.200	0.00420	0.00
6. Wheel Tractors and Mobile Machinery	HFC-134a	1.03044	1.18	1339.570	1.33957	0.95
2(II).F.2 Foam Blowing (Hard Foam)	HFC-134a, 152a, 365mfc, 227ea	38.58114	44.08	43231.701	43.23170	30.63
1. PU Insulation Panels	HFC-134a	0.07690	0.09	99.970	0.09997	0.07
2. Spray and Injection Foam	HFC-365mfc, 227ea	0.06000	0.07	61.842	0.06184	0.04
3. PU Intregral Skin Foam	HFC-365mfc	0.04200	0.05	37.380	0.03738	0.03
4. XPS Insulation Foam	HFC-134a	0.05724	0.07	74.409	0.07441	0.05
5. One Component Foam	HFC-134a, 152a	38.34500	43.81	42958.100	42.95810	30.44
2(II).F.3 Fire Extinguishers	HFC-23, 125, 134a, 227ea	0.25273	0.29	727.426	0.72743	0.52
2(II).F.4 Aerosols	HFC-134a, 152a	2.30956	2.64	3002.423	3.00242	2.13
1. Metered Dose Inhalers	HFC-134a	2.22015	2.54	2886.200	2.88620	2.04
2. General and Novelty Aerosols	HFC-134a, 152a	0.08941	0.10	116.229	0.11623	0.08
2(II).F.7 Electrical Equipment for Transmission of Electricity	SF6	0.03225	0.04	770.775	0.77078	0.55
2(II).F.8 Other Electrical Equipment	SF6	0.00120	0.00	28.680	0.02868	0.02
2(II).F.9c Sport Shoe Soles	SF6, PFC C3F8	0.02570	0.03	433.400	0.43340	0.31
Total		87.52924	100.00	141142.462	141.14246	100.00

The F-gas share of the Estonian 2006 GHG emissions based on the finished Twinning project is 0.75%.[7]

Within the 2009 NIR submission the F-gas emission data for 2006 has to be recalculated based on the new data of this report.

Sources and structure of emissions (for details see the following chapters according to the CRF-systematic):

The biggest CRF-sector is 2(II).F.1 "Refrigeration and Air Conditioning Systems" with almost 66% of the emissions (CO2 equivalents). The important areas of F-gas application in this sector are:

- Mobile Air Conditioning with about 17.4% in total (main sub sector: about 183.000 passenger cars with 12% of total emissions);
- Commercial Refrigeration, 16.3% (about 530 supermarkets, 7.000 smaller shops, 3.000 pubs, restaurants, hotels with cooling/refrigeration equipment for kitchens etc., about 15.000 stand alone vending machines);
- Industrial Refrigeration with about 13% (some 350 factories, enterprises, companies, mostly from the food industry, Estonias most important industrial sector);
- Stationary and Room Air Conditioning, ca 20.000 units in Estonia with about 10.3% of total emissions.

The second big CRF-sector is 2(II).F.2 "Foam blowing" with almost 31% of CO2 equivalents.

- This sector is dominated by the emissions from manufacturing and use of One Component Foam (OCF) for building industry. 38.3% of the F-gas emissions in metric tons and 30.4% of the F-gas CO2 equivalents come from this sub sector. Estonia is amongst the four biggest polyurethane one component foam manufacturing and exporting countries within the EU.

These are the CRF-sectors and sub sectors with more than 10% of the total F-gas emissions. They amount together to 89.8% of the total F-gas emissions in CO2 equivalents and 85.1% in metric tons.

Other sectors with more than 1% of the total emissions (CO2 equivalents) are

- Refrigerated vehicles (7.8%),
- Metered Dose Inhalers (2.0%)
- Trucks (1.8 %)
- Ships (1.6%).

[7] Estonias GHG emissions in 2006 was 18876.18 Gg CO2 equivalents as reported in the 2008 NIR submission plus additional 65.16 Gg CO2 equivalents F-gas emissions from the finished Twinning project = 18941.34 Gg CO2 equivalents in total. The share of F-gas emissions (141.14 Gg CO2 equivalents) is 0.75%.

The investigation revealed some details not only of importance for the Estonian F-gas inventory but of general interest, e.g. in the field of emission factors (cf. the chapters on ships, commercial and industrial refrigeration).

3.5 "F-gas intensity" and plausibility of the results

Table 2 and 3 give some information on the "F-gas intensity" (F-gas emissions related to population and GDP) and compare the structure of the 2006 Estonian F-gas emissions with the respective emissions of another EU member state (Germany) and some socio-economic basic data of both countries.

Tab. 2: F-gas emissions 2006: Basic data Estonia/Germany

Basic data 2006	Estonia	Germany	Estonia/ Germany (%)	source
F-gas emissions (Gg CO2 equiv.)	141.142	15 730.0	0.90	Twinning project; NIR Germany 2008,p.43
Population (millions)	1.345	82.438	1.63	www.stat.ee/29908
F-gas emissions (kg CO2 equiv./capita)	104.9	190.8	55.0	own calc.
GDP/capita (€)	9.839	28.161	34.9	www.stat.ee/29880; own calc.
Car density per 1000 population	412	565	72.9	ARK/KBA; own calc.

ARK: Estonian Motor Vehicle Registration Centre; KBA: German Kraftfahrzeugbundesamt

- Estonia has in total nearly half (55%) of the per capita F-gas emissions of Germany (105 vs. 191 kg). Emissions of F-gases in Germany in 2006 amounted to 1.6% of the total GHG emissions, in Estonia this share was 0.75%. Estonia's "F-gas intensity" is, compared to Germany, smaller.

Tab. 3: Structure of F-gas emissions 2006: Comparison Estonia/Germany (Gg CO2 equiv.)

F-gas	Estonia			Germany		
	abs. (Gg CO2 equiv.)	%	Per capita (kg CO2 equiv.)	abs. (Gg CO2 equiv.)	%	Per capita (kg CO2 equiv.)
HFC	139.90960	99.130	104.0	9 815	62.4	119.1
PFC	0.07490	0.053	0.1	582	3.7	7.1
SF6	1.15796	0.820	0.8	5 333	33.9	64.7
F-gas in total	141.14246	100.0	104.9	15 730.0	100.0	190.8

- Amongst the F-gas emissions of Estonia HFCs dominate with more than 99%; in contrast they count in Germany for less than 2/3 of total GHG emissions and PFC and especially SF6 represent another 1/3.

- The difference of "F-gas intensity" between both countries is not so big with regard to the HFCs (104 vs. 119 kg per head) used in the most important Estonian CRF-sectors 2(II).F.1 ("Refrigeration and Air Conditioning Systems") and 2(II).F.2 "Foam blowing". The difference is

very distinct with regard to PFC and SF6. These F-gases are of greater importance in some applications (e.g. soundproof glazing, production of aluminium, magnesium casting; semiconductor manufacturing) which are without relevance in Estonia.

- The Estonian GDP/capita value amounts to some 1/3 of the German figure, the Estonian car density is more than 2/3 of the German value. This reflects at one hand a lower level of industrialization – combined with a lower productive consumption of PFC and SF6 used in industrial appliances – and a higher level of individual consumption (car density as indicator) combined with use of HFC.

The order of magnitude of F-gas emissions found in this investigation in relation to the magnitude of total GHG emissions from Estonia and compared to the emissions of a strongly industrialized EU member state like Germany is absolutely plausible.

4. Open questions

Source-specific planned improvements and open questions are mentioned in the following chapters. As next step times series should be established. Basic year for F-gases is 1995.[8]

[8] Ministry of the Environment of Estonia, Report to facilitate the estimation of Estonia's assigned amount under the Kyoto Protocol, Tallinn, October 24, 2006 (http://unfccc.int/national_reports/initial_reports_under_the_kyoto_protocol/items/3765.php).

2(II).F.1 REFRIGERATION AND AIR CONDITIONING SYSTEMS

Refrigeration and Air Conditioning Systems are responsible for about 65.9% of the Estonian F-gas emissions (CO_2 equivalents). The big sub sectors are

a) Domestic Refrigeration (fridges and freezers for domestic use),
b) Commercial Refrigeration (refrigeration units for supermarkets and smaller shops, restaurants etc.),
c) Transport Refrigeration (refrigerated vehicles and reefer containers),
d) Industrial Refrigeration (refrigeration units in the food and other industries),
e) Stationary Air Conditioning (heat pumps and room air-conditioning systems),
f) Mobile Air Conditioning (AC systems for passenger cars, trucks, buses, ships, railcars, wheel tractors/mobile machinery).

2(II).F.1a DOMESTIC REFRIGERATION

Small sub sector with less than 0.3% of the Estonian F-gas emissions (0.394 Gg CO_2 equivalent). The sector was not yet presented in the NIR 2006.

Source-category description

Refrigerators (fridges and freezers) for domestic use are not manufactured in Estonia but imported (new and second hand). To some degree HFC-134a is used as refrigerant and as foam insulating gas. HFC-134a as refrigerant was introduced by industry at the end of 1993 as replacement of CFC-12. In the following years, its replacement by R600A (iso-butane) started in some countries (Germany) but not in all countries in Europe and North-America. Today only a small part of imported new domestic refrigeration equipment operates with HFC-134a (1% according to Estonian experts). The share of HFC-134a in the Estonian stock of fridges/freezers is (depending on imports from different manufacturers) bigger and is estimated 12.5%.

Methodological issues

In 2006 Estonia had – according to the statistical office – 573,387 households with 529,436 refrigerators. The number of newly imported fridges/freezers in 2006 is estimated at 56,000, about 5% of which are freezers (data from importers and EES Ringlus [Estonian Association for Recycling of Electrical and Electronic Equipment]). The share of fridges/freezers with HFC-134a in the stock is estimated by Estonian experts at 66,000 (12.5%) à 150 g HFC-134a refrigerant, in total 9,900 kg HFC-134a. In newly imported/bought systems – annually 56,000 units – some 1% contains HFC-134a, 84 kg per annum in total. Lifetime of domestic refrigeration equipment in Estonia is calculated by industry at not less than 15 years.

Emission factors: EES Ringlus reports that in 2006 5% of 15,000 fridges (750 units) collected for recycling contained HFC-134a as refrigerant with a loss of 25-30% of the original charge. The annual operating emission rate is, following this information, 2%/year (EF_{op}). This country specific emission

factor is higher than the IPCC 2006 guidelines default value of max. 0.5%/year.

The number of refrigerators decommissioned per annum can be calculated (based on 15 years lifetime) at 35,000 from which 15,000 are collected by the recycling companies and sent for treatment to foreign countries (mostly Finland); the remaining 20,000 are disposed without refrigerant recovery. If we assume (i) that 5% of these 20,000 non-collected refrigerators contain R-134a, and (ii) that in each of them 70% of the original 150 gram charge is left (30% already emitted), the disposal HFC-134a emissions are 105 kg ($EF_{disposal}$ = 100%).

Method according to IPCC guidelines 2006: Tier 2a with country specific EF.

- Country specific average refrigerant charge per unit: 150 g R-134a
- Country specific operating emission factor: 2%

The total 2006 amount of R-134a emissions is 0.3 tons (stock emissions: 198 kg, end-of-life emissions: 105 kg) representing 393.9 tons CO_2 equivalent (0.394 Gg).

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts according to approach 1 of the 2006 IPCC Guidelines.

The data are based on direct information from industry, so that the UN of the activity data on the number of units (stock, annual importation, annual decommissioning) can be estimated relatively low (± 10%). The UN of the emission factor is assessed ± ~10%, so that the combined UN of the emissions (operating and disposal) is estimated ± 15%.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC was carried out by the data collecting expert and co-operators.

Source-specific recalculations

As 2006 is the first year of the F-gas inventory no preceding data could be recalculated.

Planned improvements (source-specific)

Recalculation of emissions and establishment of time series.

Documentation

Paper documents: Folder 1, sector 4
Electronic documents: Folder 01-08 Refrigeration&stat AC; 04 domestic refrigerators and freezers

2(II).F.1b COMMERCIAL REFRIGERATION

Important sub sector with almost 16.3% of the Estonian F-gas emissions (22.972 Gg CO_2 equivalent). The sector was not yet presented in the NIR 2006.

Source-category description

Commercial refrigeration and its main sub sector, supermarkets, is one of the big application sectors of fluorinated refrigerants and emissions in Estonia. This report distinguishes between

- Supermarkets and other food retail shops with mostly on-site assembled centralized systems; main HFC refrigerant: R-404A (more than 95%).
- Small shops and institutions with comparable refrigeration units (only one compressor and/or less than 15 kg refrigerant; this sub sector includes small shops with less than 3 kg refrigerant); HFC-refrigerants in use: mostly R-404A (63% of HFC-refrigerants) and R-134a (31%).
- Refrigeration equipment for restaurants, hotels, pubs, canteens etc. (mostly small stand alone equipment for kitchens and cold rooms, 0.75 kg average refrigerant charge); HFC-refrigerants: 2/3 R-404A, 1/3 R-134a.
- Stand alone or plug-in equipment (mostly vending machines for shops, filling stations etc., on average 250 g R-134a/device).

The commercial refrigeration sector is dominated by the refrigerants R-404A which make 88% of the 2006 HFC stock (mostly used in supermarket systems) and R-134a (more than 9%, mainly used in vending machines and small shops). Other HFC refrigerants (R-407C, R-507A, R-410A or the R-152a containing mixture R-401A) are only of less importance.

The Estonian refrigeration equipment in general is quite modern because the change from the formerly so called open market system to the present-day supermarket system occurred during the last 15 years. The biggest sector with older equipment including second hand cabinets is the small shop sector. In this sub sector the amount of HCFC R-22 still surmounts the HFC-consumption. (In the supermarket sector the R-22 quota of all refrigerants in use was less than 4%, in the small shop sector almost 45%).

The 2006 number of food retail supermarkets in Estonia – hypermarkets, supermarkets, discounters, department stores – was according to the Estonian Traders Association about 530, the number of small commercial and public customer orientated service institutions with refrigeration equipment (like small shops, medical institutions, hotels, restaurants, canteens etc.) according to other statistical sources (e.g. www.eniro.ee) more than 10,000. This includes according to expert calculation from refrigeration service companies about 7,000 small shops with less than 3 kg refrigerant charge plus about 3,250 hotels, bars, restaurants, pubs, canteens etc. with 0.75 kg refrigerants on average. The number of vending machines for cooling of beverages and other goods (stand alone equipment) was calculated at about 15,000 units at maximum.

Methodological issues

Supermarkets: The refrigeration systems of supermarkets are maintained by specialised service companies. Most of them install and service the systems, some are specialised on service activities. Ten service companies provided the activity data (stock, new installations in 2006, refilling data) on the HFC (and also HCFC) refrigerant consumption of their clients in the supermarket sector. One supermarket chain has its own service management. The 2006 stock data compilation from the service companies (31.5 tons HFC) had to be completed in two cases by assessment of the stock (additional 6 tons or 16% of the sum of 37.5 tons). This assessment was based on the refilling data provided by the two service companies. In this case the amount of HFC used for refilling is estimated to be in the order of 10% of the stock. The assessment is conservative and low with the aim not to overestimate the stock (the country specific emission rate EF_{op} is calculated higher [15%], see below).

According to Estonian experts the service companies covered – in terms of quantity of refrigerants – 90% of the supermarket HFC consumption. Thus 10% was added resulting in a total amount of 41.1 tons of HFC for the 2006 stock of supermarkets.

Small shops: Nine service companies (seven of them also active in the supermarket sector) submitted activity data about smaller shops. In one case the stock data had to be estimated by the inventory compilers (same method as with the supermarkets, based on a low refilling ratio of 10%). In this sub sector also a 10% surcharge was added (484 kg) resulting in a total stock of 5.3 tons HFC. The quality of the data collection can be seen by the following: One service company estimated the sub sector at 7,000 shops à 1.4 kg HCFC- and HFC-refrigerants (one cabinet for minus cooling with 500 g charge and three cabinets for normal cooling with 300 g each) resulting in estimated 9.8 tons refrigerants in total. The amount of all refrigerants reported by the service companies (HCFC and HFC) for the small shop sub sector is 8.5 tons (some 85% of the assessment).

Restaurants etc.: The companies installing and servicing refrigeration equipment for restaurants, canteens and similar institutions did not provide stock data. The respective stock was estimated based on a number of 3,250 possible clients with on average 0.75 kg refrigerant quantity resulting in about 2.4 tons HFC-refrigerant. (In 2006 the companies sold new equipment with 180 kg refrigerants; based on a lifetime of 15 years this results in an estimated stock of 2.7 tons.) The percentage of R-134a is estimated by Estonian experts at 2/3 (1.63 tons), the percentage of R-404A with 1/3 (0.81 tons).

The number of vending machines in Estonia (15,000 à 250 g refrigerant) was extrapolated on basis of data from the two biggest manufacturers of beer and other beverages delivering such machines to Estonian shops. The HFC-charge amounts to 3.75 tons R-134a.

The lifetime of refrigeration systems for supermarkets and small shops including kitchen systems in Estonia is according to experts from the

mentioned companies on average about 15 years (vending machines shorter, 5-10 years).

Emissions: The service companies were asked for 2006 stock data and refilling data of their clients. The refilling ratio of R-404A (refilling compared to stock) for the commercial refrigeration sector in total is 14.6%. In the supermarket sub sector this refilling ratio is higher at the clients of the service companies that reported refilling and stock data (five service companies, refilling ratio 16%) but lower (12.4%) when all companies are considered, amongst them also such ones without refilling data and incomplete stock data.

The refilling ratio calculated on basis of all refrigerants (HFC and HCFC) is higher (20%). This should be mainly be due to the use of older and less carefully serviced equipment in the small shop sector. A refilling ratio of 20% was also identified for the sector of restaurants and other places with refrigeration demand for kitchens etc. but this can be accepted only with reservation as the data base is too small.

Normally emissions are higher than the refilling ratio. A certain fraction of emissions is never replenished by refilling. On the other hand the Estonian data base is still too small to allow a more detailed emission rate calculation. Therefore an EF_{op} of 15% is applied to all sectors covering emissions from operating and servicing with the only exception for vending machines. The vending machines in the Estonian market are modern and should be very tight; the emission rate EF_{op} is estimated at 1.5%/year. These emission factors are in the range of the IPCC guidelines 2006 (10-35% for medium and large commercial refrigeration and 1-15% for stand alone commercial refrigeration).

The EF_{manu} (filling of new equipment) is estimated at a low value of 0.5% which is likewise in accordance with the IPCC Guidelines 2006.

Method according to IPCC Guidelines 2006: Tier 2a with country specific determination of EF.

- Country specific EF_{manu} (filling): 0.5%.
- Country specific operating emission factor EF_{op}: 15% (vending machines: 1.5%).

The total quantity of HFC filled into new commercial refrigeration equipment in 2006 amounts to 4.77 tons (4.6 tons R-404A and a small amount of R-134a). The manufacturing emissions from this filling are 24 kg. The HFC stock amounts to 53.1 tons (45.2 tons R-404A, 7.1 tons R-134a and small amounts of R-407C, R-152a and R-410a). The stock emissions are in total 7.4 tons. The biggest part of them is HFC-404A (6.8 tons) and HFC-134a (0.6 tons), the emissions of the other HFC are only 57 kg. The CO_2 equivalent of all 2006 HFC emissions is 22.972 gG (22,972 tons).

Method according to IPCC Guidelines 2006: Tier 2a with country specific determination of EF.

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts. The combination of the individual uncertainties follows the approach 1 of the 2006 IPCC Guidelines.

The UN of the two activity data "Filled in new manufactured products" and "HFC stock in operating systems" is estimated ± 20% (0,2).

The combination of this value with the respective emission factors (± 10%) results in the UN of both manufacturing and operating HFC emissions of ± ~22%.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC was carried out by the data collecting expert and co-operators.

Source-specific recalculations

As 2006 is the first year of the F-gas inventory no preceding data could be recalculated.

Planned improvements (source-specific)

In 2008, the time series 1995-2005 shall be established.

Estonia reported already for 2006 on 18.9 kg PFC-218 as component (9%) of the refrigerant blend R413A which was sold in 2006 within the country (commercial refrigeration sector).[9] Consumption of and emissions from this refrigerant could not be found within the Twinning project. It should be investigated for the next reporting.

Documentation

Paper documents: Folder 3, sector 8
Electronic documents: Folder 01-08 Refrigeration&stat AC; 07-08 IndCommRef activity data; 08 Commercial refrigeration

[9] NIR Estonia 2008, p. 85.

2(II).F.1c TRANSPORT REFRIGERATION

This group includes refrigerated vehicles and refrigerated (reefer) containers. It is responsible for about 8.2% of the Estonian F-gas emissions (11.623 Gg CO_2 equivalent). The NIR 2006 presents the data of refrigerated vehicles only.

1. Refrigerated Vehicles

Source category description

By 31.12.2006, about 1.300 refrigerated vans and trucks and 800 refrigerated trailers were registered in Estonia. Most of these vehicles are second hand vehicles imported from Western Europe. The average age of e.g. refrigerated trucks new-registered in Estonia in 2006 was 8.7 years. Approx. half the refrigeration units fitted to the imported second-hand trucks and trailers are empty and are charged with refrigerant within the country (second-hand vans: approx. 20%). Only a small number of new vans are fitted with refrigeration units first in Estonia, and as a consequence, first-filled in the country. The refrigerants in use are R-134a in case of vans and smaller trucks, and the blend R-404A in case of bigger trucks and of trailers. Refrigeration units of older vehicles still operate with HCFC R-22.

Methodological issues

The Estonian Motor Vehicle Registration Centre (ARK) provided a list of all refrigerated vehicles registered at the end of 2006, subdivided in weight classes (N1, N2, and N3 according to 2001/16/EC), makes, models and production years dating back to 1995 and beyond.

Information on the types of refrigeration units of the Estonian vehicles, the HFC-types they are charged with, the refrigerant charges, the emissions and the frequency of refilling was provided by the two biggest service companies for refrigerated vehicles. Both are linked to the leading international manufacturers of refrigeration units for trucks and trailers.

The share of older refrigeration units with non-HFC-refrigerants was estimated max. 7%. Vans and smaller trucks (class N1 and half of class N2 according to 2001/16/EC) run R-134a systems (average charge 2.0 kg/unit), bigger trucks (half of class N2 and the class N3) run R-404A systems (average charge 5.8 kg/unit). For trailers an average charge of 8.0 kg R-404A is supposed.

The Estonian experts estimate the emissions at first domestic filling (empty units of imported new and second-hand vehicles) at 1%. These emissions are equated to the CRF emission category “emissions from manufacturing”. The annual losses from the operating systems (emissions from stocks) including service emissions on refilling amount to average 30% (EF_{op} – operating emission factor) of the refrigerant stock in the refrigerated vehicles.

Method according to IPCC Guidelines 2006: Tier 2a with country specific determination of EF.

- Country-specific average refrigerant charges per unit: weight classes N1 and half N2: 2 kg; N3 and half weight class N2: 5.8 kg; trailers: 8.0 kg.
- Country-specific manufacturing emission factor: 1%
- Country-specific operating emission factor: 30%.

The total 2006 quantity of HFCs filled in empty units of refrigerated vehicles in Estonia amounts to 154 kg R-134a and 887 kg R-404A, the "manufacturing" emissions on these first fills are 1.5 kg R-134a and 8.9 kg 404A; the HFC stock in refrigerated vehicles amounts to 780 kg R-134a and 10,921 kg R-404A; the stock emissions are 234 kg R-134a and 3,276 kg R-404A. The CO_2 equivalent of all 2006 HFC emissions is about 11,015 tons (11.015 Gg).

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts. The combination of the individual uncertainties follows the approach 1 of the 2006 IPCC Guidelines.

The UN of the two activity data "First fill of empty systems" and "HFC stock in operating vehicles" is estimated ± 8.5%, which is the combination of the individual UN of a) total registrations (new or operating) by weight categories in 2006 (± 1%), b) refrigerant charges (± 6%) and c) refrigerant split into R-134a and R-404A (± 6%).

The combination of the UN of new fill or of stock (± 8.5%) with the UN of the respective emission factors (± 5%) results in the UN of both manufacturing and operating HFC emissions of ± 10%.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

Recalculations were not necessary because previous years have not been estimated.

Planned improvements (source-specific)

In 2008, the time series 1995-2005 shall be established.

In the future, attempts should be made to determine more precisely the share of second hand imports with empty refrigeration units.

Documentation

Paper documents: Folder 1, sector 1
Electronic documents: Folder 01-08 Refrigeration&stat AC; 01 refrigerated vehicles

2. Reefer Containers

Source category description

Reefer containers are being transported on sea ships around the world, and HFC emissions from their refrigeration systems do not occur inside a particular country. As a consequence, it is plausible to attribute the emissions of the worldwide reefer container fleet to a particular nation according to the share of this country in world trade. Estonia's share in the world trade amounted according to the Statistical Office to 0.1% (0.097%), in 2006, so that it is responsible of 0.097% of HFC stock and HFC emissions of the worldwide reefer container fleet.

Methodological issues

The starting point of the estimation is not country-specific but worldwide data. As this data for the 1995-2006 period was already available in the German F-gas inventory, own research on worldwide HFC stock and emissions was not necessary. Only the share of Estonia in the world trade had to be identified.

The worldwide HFC stock (German F-gas inventory) was estimated in three steps:

1. Annual number of 20 feet units (new manufactured, decommissioned, total stock).
2. Refrigerant charge per set (6 kg of 134a or 4 kg of 404A).
3. HFC-split between R-134a and R-404A (80% to 20%).

The emissions of R-134a and R-404A are calculated by means of emission factors. The operating emission factor is 10%[10], the disposal emission factor is 30%. (Manufacturing emissions are not distributed by world trade shares but are estimated in the (few) countries of container manufacturing).

Information about the 2006 share of Estonia in the world trade (both export and import) was given by the Statistical Office.

From 2007 onwards, the annual updating of the worldwide data does no longer rely on the German inventory. Data on the worldwide reefer production are annually published by the information service *World Cargo News*.

Method according to IPCC Guidelines 2006: Tier 2a with international default EF.

The 2006 HFC emissions from reefer containers attributable to Estonia are 364 kg R-134a (473 t CO_2 equ.) and 42 kg R-404A (136 t CO_2 equ.). The total is 608.5 t or 0.609 Gg CO_2 equivalent.

[10] UNEP, 2002 Report of the Refrigeration, Air Conditioning and Heat pumps technical options committee 2002 Assessment, Nairobi, January 2003, p. 92.

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts. The combination of the individual uncertainties follows the approach 1 of the 2006 IPCC Guidelines.

The UN of the basic activity data "worldwide HFC stock" is the same as in the German inventory: ± 8.4%, which is the combination of the individual UN of a) number of units (± 3%), b) HFC-charges (± 5%), c) HFC-split (± 6%).
The UN of the Estonia share in world trade is estimated ± 3%, and the UN of the operating emission factor ± 5%. The combined UN of the HFC emissions (both 134a and 404A) can be calculated ± 10.2%.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

Recalculations were not necessary because previous years have not been estimated.

Planned improvements (source-specific)

In 2008, the time series 1995-2005 shall be established.

Documentation

Paper documents: Folder 1, sector 2
Electronic documents: Folder 01-08 Refrigeration&stat AC; 02 refrigerated containers

2(II).F.1d INDUSTRIAL REFRIGERATION

Important sub sector with little more than 13% of the Estonian F-gas emissions (18.362 Gg CO_2 equivalent). The sector was not yet presented in the NIR 2006.

Source-category description

Industrial refrigeration is a big application sector of fluorinated greenhouse gases, mainly of HFC R-404A. The dominant application is the food industry (fish, meat, dairy, beverage industries, breweries, etc), which is Estonia's most important industrial sector. The food industry's dynamic may be exemplified by the fact that its output has tripled in the 1995-2005 decade.[11] The HFC consumption of other industries (e.g. chemical industry) is comparably small.

In contrast to commercial refrigeration, in industrial refrigeration non-HFC/HCFC refrigerants – especially NH_3 – play a major role than HFC. With regard to the HFC stock R-404A is the prevailing refrigerant with a share of almost 95%. As to the annual consumption of HFC and CFC/HCFC, the share of R-404A is some 70%, with R-22 being the second refrigerant of importance with 26%. Other HFC refrigerants (R-134a, R-402A, R-407C, R-507A or the R-152a containing mixture R-401A) are of minor importance.

The refrigeration systems are very often served by bigger service companies; however, self maintenance and cooperation with smaller (locally based) service companies is of more importance than in the supermarket and food retail sector.

Methodological issues

Information on potential HFC users in the food and other industries was compiled in cooperation with experts from refrigeration service companies specialised on industrial application. Food industry's basic data can be found in the statistics of the Veterinary and Food Board (VTA; cf. www.vt.agri.ee) because companies wishing to handle foodstuff must be approved by the VTA. Approved enterprises: Fish industry - more than 60 plants with chilling/freezing equipment; meat industry - 120 plants; dairy industry – 38 plants.

Thirteen service companies provided the activity data (stock, new installations in 2006, refilling data) on the HFC consumption of their industrial clients. In two cases the service companies could not report on stock data. These data had to be completed by our assessment. (The assessment is based on the refilling data provided by the service companies, and the stock is assumed to be 10 times higher than the annual refills; same method as with the supermarket sector).

[11] Ministry of Economic Affairs and Communications/Ministry of Finance, Economic Survey of Estonia 2005, Tallinn 2006, p. 17ff.

In addition to the service companies, approx. seventy companies from the fish, meat, dairy, bakery, beverages and other food-industries, and from several non-food industries (including e.g. ice rinks) were directly interviewed by dedicated questionnaires about their HFC (and also HCFC) refrigerant consumption.

As the refrigerant stock based on the data from service companies and directly interviewed industry covers the total stock to a certain part only, the remaining stock had to be estimated by us in cooperation with national sector experts. The thus assessed percentage of the HFC stock in industrial refrigeration is 21.8 tons or 53.3% of the total HFC stock (40.9 tons, reported and assessed). Two thirds of the estimated HFC stock amount is attributable to one big service company who could not provide stock data for 2006 but only data on 2006 newly installed systems. Better stock data from this company will significantly enhance the overall quality of the stock data, in the future.

The average lifetime of industrial refrigeration systems in Estonia is about 15 years or more, according to experts from the mentioned companies.

Emissions: The service companies and the industrial companies surveyed by questionnaires were asked for 2006 stock and refilling data. Complete stock and refilling data for HFC-404A are available for 22 individual companies in the fish, meat, milk, and beverage industry, with an HFC-404A stock of 10.3 tons. The refilling ratios of the individual companies range from 0 to 48%. The average refilling rate is 14.8%. Excluding the company with highest refilling ratio of 48%, the total amount of the HFC stock is reduced to 10 tons and the average refilling ratio to 13.9%.

As in the case of commercial refrigeration the emission factor (EF_{op}) for the stock is country specific, i.e. is based on the average refilling ratio in the industry, with 14%. This emission factor is in the range of the IPCC guidelines 2006 (7-25% of the stock).

The EF_{manu} (filling of new equipment) is estimated at a low value of 0.5% which is likewise in accordance with the IPCC Guidelines 2006.

Method according to IPCC Guidelines 2006: Tier 2a with country specific EF.

- Country specific EF_{manu} (filling): 0.5%.
- Country specific operating emission factor EF_{op}: 14%.

The total quantity of HFCs filled into new industrial refrigeration equipment in 2006 amounts to 5 tons (2.6 tons HFC-143a, 2.2 tons HFC-125 and 0.2 tons of HFC-134a). The manufacturing emissions from filling are 25 kg. The HFC stock amounts to 40.9 tons (20.4 tons HFC-143a, 17.7 tons HFC-125 and 2.6 tons of HFC-134a, and small amounts of HFC-32 and HFC-152a). The stock emissions total 5.7 tons. The biggest parts of them are HFC-143a (2.9 tons), HFC-125 (2.5 tons) and HFC-134a (363 kg); the emissions of the other HFCs

are only 30 kg. The CO_2 equivalent of all 2006 HFC emissions is 18.362 Gg (18,362 tons).

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts. The combination of the individual uncertainties follows the approach 1 of the 2006 IPCC Guidelines.

The UN of the two activity data "Filled in new manufactured products" and "HFC stock in operating systems" is estimated ± >25% (26%) This high value mainly results from the high share of estimations in the determination of total HFC stock. The combination of this value with the UN of the respective emission factors (± 15%) results in the UN of both manufacturing and operating HFC emissions of ± 30%.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

As 2006 is the first year of the F-gas inventory no preceding data could be recalculated.

Planned improvements (source-specific)

In 2008, the time series 1995-2005 shall be established and the stock data (share of assessed stock) shall be improved.

Documentation

Paper documents: Folder 2, sector 7
Electronic documents: Folder 01-08 Refrigeration&stat AC; 07-08
IndCommRef activity data; 07 Industrial refrigeration

2(II).F.1e STATIONARY AIR CONDITIONING

Stationary Air Conditioning includes the sub-applications heat pumps and equipment for stationary and room air conditioning with HFC-134a, R-407C and R-410A. The NIR 2006 presents the data of both sub sectors, which cover about 10.6% of the Estonian F-gas emissions in 2006 (15.022 Gg CO_2 equivalent).

1. Heat Pumps

Source-category description

The use of heat pumps with HFC refrigerants – ground and air heat pumps – started in Estonia in 1993. Decommissioning has not yet occurred because the bulk of the systems were installed in the last years. Ground heat pumps generally operate with HFC-407C, air heat pumps with HFC-410A. In general, heat pumps are imported to the country and already charged with refrigerant. Only a small number of ground heat pumps was manufactured and filled with refrigerant in Estonia itself.

Methodological issues

The leading expert of the Estonian Heat Pump Association provided information on heat pumps in Estonia in cooperation with the three biggest suppliers of heat pumps in the country. In order to avoid double counting, the classification of heat pumps on the one hand and stationary respective room air conditioning systems on the other hand was discussed together with experts from the Estonian Refrigeration Association. According to the experts the stock of installed heat pumps in Estonia amounts to approx. 10,000 systems in 2006 (3,000 ground and 7,000 air heat pumps), nearly half of them were installed in 2006 (4,750). The average charge was estimated at 2.0 kg for ground and 1.0 kg refrigerant for air HP. The new systems are mainly (85%) air heat pumps. The discussion with Estonian experts resulted in emission factors for manufacturing (EF_{manu}) of 2.0% and for operating systems (EF_{op}) of 2.5%.

Method according to IPCC Guidelines 2006: Tier 2a with country specific determination of EF.

- Country-specific EF_{manu}: 2%
- Country-specific EF_{op}: 2.5%.

The domestic consumption filled in new ground HP is 60 kg R-407C, the manufacturing emissions 1.2 kg R-407C. The 2006 operating stock amounts to 6,000 kg R-407C (ground HP) and 7,000 kg R-410A (air HP). The 2006 operating emissions total 150 kg R-407C and 175 kg R-410A.

All global warming emissions together amount to 532.5 t CO_2 equivalent (0.5325 Gg).

Uncertainties and time-series consistency

Öko-Recherche experts assessed the emissions uncertainty (UN) pursuant to approach 1 of the 2006 IPCC Guidelines. The data on heat pumps are deemed precise because the relevant associations, companies and experts for heat pumps and refrigeration systems in Estonia, provided them.

The UN of the activity data HFC consumption and HFC stock is estimated at ± 9%. The emission factors are estimated ± 5%. The combination of the UN of the stock/consumption with the UN of the emission factors results in the UN of the HFC emissions of ± 10.3%.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC was carried out by the data collecting expert and co-operators.

Source-specific recalculations

Recalculations were not necessary because previous years have not been estimated.

Planned improvements (source-specific)

In 2008, the time series 1995-2005 shall be established.

Documentation

Paper documents: Folder 1, sector 3
Electronic documents: Folder 01-08 Refrigeration&stat AC; 03 Heat Pumps

2. Stationary and Room Air Conditioning

Source-category description

Stationary and room air-conditioning systems including chillers, ventilation and split systems are generally imported. Split systems are imported with HFC charge, newly installed chillers (2006: 40 systems) and ventilation systems (2006: 400 systems) are first-filled inside the country. In these cases emissions from filling (manufacturing) have to be considered. Refrigerants in use for chillers are HFC-134a and the blend R 407c, for ventilation systems and split systems the blends 407C and R 410A.

Methodological issues

The 2006 newly installed systems, the total 2006 equipment stock, the refrigerant charges by weight and HFC types, and the EF for domestic manufacturing and operating stock were determined in cooperation with the experts from the Estonian Refrigeration Association and companies (manufacturers, traders, service companies) belonging to this association. As mentioned in the heat pump section, the heat pumps on the one hand, and stationary and room air conditioning systems on the other hand were discussed together with the Estonian Heat Pump Association to avoid double counting. The interviews revealed for 2006 the following numbers of operating systems: 400 chillers, 2,800 ventilation systems and 16,000 split systems ("mini-splits"). The EF_{manu} (first filling loss) was established at 20g/system for chillers (0.019%) and 40g/system (factor: 0.24%) for ventilation systems, the EF_{op} (Product Life Factor) at 1% (chillers), 12.5% (ventilation systems) and 3% (split systems). Chillers and split systems are industrially manufactured and tighter than ventilation systems that are assembled on site.

Method according to IPCC Guidelines 2006: Tier 2a with country specific determination of EF.

- Country-specific EF_{manu}: 20g and 40g per system;
- Country-specific EF_{op}: 1% (chillers), 12.5% (ventilation) and 3% (split).

The domestic consumption filled in new systems (chillers and ventilation) is 3.15 t R-134a, 1.002 t R-410A, 6.65 t R-407C. Manufacturing emissions: 0.6 kg R-134a, 2.4 kg R-410A, 13.8 kg R-407C. The operating stock amounts to 24 t R-134a, 5.5 t R-410A and 71.22 t R-407C. Operating emissions: 260 kg R-134a, 403 kg R-410A, 9,24 t R-407C.

All global warming emissions together amount to 14,489 t CO_2 equivalent (14.489 Gg).

Uncertainties and time-series consistency

Öko-Recherche experts assessed the emissions uncertainty (UN) pursuant to approach 1 of the 2006 IPCC Guidelines. The relevant associations, companies and experts in Estonia very roughly estimated the data on stationary A/C systems, especially on emission factors of split systems and chillers. The UN of the activity data HFC consumption and stock is estimated at ± 15%. The UN of the ventilation emission factors is ± 10%. The UN of the

EF for chillers and split systems are more uncertain (± 26%); they are supposed to be too low. The combination of the UN of stock/consumption with the UN of the (given) emission factors results in the UN of the HFC emissions of ± 30% (chillers, splits), and ± 18% (ventilation systems).

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC was done by the data collecting expert and co-operators.

Source-specific recalculations

Recalculations were not necessary because previous years have not been estimated.

Planned improvements (source-specific)

The emission factors of split systems and chillers estimated by the national sector experts are deemed by far too low compared with values discussed in other countries. They should be reviewed in the next years. In 2008, the time series 1995-2005 shall be established.

Documentation

Paper documents: Folder 1, sector 5/6

Electronic documents: Folder 01-08 Refrigeration&stat AC; 05-06 Stationary & Room AC

2(II).F.1f MOBILE AIR CONDITIONING

This group includes passenger cars, trucks, buses, ships, railcars and wheel tractors/mobile machinery. The NIR 2006 presents the data of ships only. The sector is responsible for about 17.4% of the Estonian F-gas emissions (24.576 Gg CO_2 equivalent).

1. Passenger Cars

Source category description

In 2006, there were about 507,000 passenger cars in traffic register of Estonia, only a minority of them being first-registered in Estonia itself (29%) because by far most of these cars are imported second-hand vehicles. In Western Europe systematic air-conditioning of passenger cars with the refrigerant HFC-134a had started in 1994. As 292,000 vehicles of the Estonian passenger cars have been manufactured from 1994 onwards more than half the vehicles are potentially air-conditioned. Equipment of these younger vehicles with air-conditioners is high – reaching over 90% in most recent years. The relevant MAC properties (equipment quota, refrigerant charge, leakage rate) depend on car makes and models. The refrigerant charge of passenger car MAC systems ranges from 0.39 kg to 1.24 kg, the emission rate is estimated 10%.

Methodological issues

The Estonian Motor Vehicle Registration Centre (ARK) provided a list of all passenger cars registered at the beginning of 2007, subdivided in makes and production years (dating back to 1994 and beyond), and with regard to the latest registration year also in different car models. No official data about air conditioning were obtainable.

Since the MAC data depends on specific car models, the essential information for the estimation of the HFC stock in the cars of Estonia was available only for the 2006 registrations. The predominant origin of the Estonian cars from Western Europe (Germany is the biggest source of second hand cars in Estonia) suggested the conjecture that the average MAC data of the Estonian car park does not significantly differ from the analogous West European figures. In order to validate this hypothesis the quantitative model composition of the Estonian registration year 2006 was compared with the quantitative 2006 model composition of the German car park. As a result it emerged that the Estonian average figures indeed only marginally deviate from the German ones.

This substantial congruence in the 2006 MAC figures made the assumption plausible that such congruence also exists for the previous registration years. Consequently, the German 1994-2005 average figures were applied to respective registration years in the Estonian car park. This approach allows that the individual Estonian registration years do not need to be divided into the numerous models they consist of. The Estonian 1994-2005 MAC quotas are considered equal to the German MAC quotas, the Estonian 1994-2005

MAC charges are considered 2% smaller than the analogous German charges.

The emissions from the refrigerant stock in the car park are estimated applying the leakage rate established in the 2003 EU study[12], which the authors of this study claim to be representative of EU countries.

Method according to IPCC Guidelines 2006: Tier 2a with europe specific determination of EF.

- Country-specific average refrigerant charge: 644 grams.
- Emission factor: 10%.
- MAC quotas: In the total fleet, the MAC quotas vary by the production years. As the historical quotas 1992-2005 cannot be gathered in 2007, the German values were applied. The relatively high share of German passenger cars in the Estonian potentially air-conditioned fleet justifies this.

The total HFC-134a stock in passenger car MACs in Estonia amounts to 130,814 kg in the year 2006. The HFC-134a emissions from the Estonian passenger car fleet in 2006 total 13,081 kg (10%), the CO_2 equivalent of which is about 17,006 tons.

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts. For the combination of individual uncertainties approach 1 of the 2006 IPCC Guidelines was applied.

The UN of the basic activity data "HFC stock" is estimated ± 8.5%, which is the combination of the individual UN of a) total registrations in 2006 (± 1%), b) MAC quotas (± 6%), c) refrigerant charges (± 6%) – with most quotas and charges being taken from Germany.

The combination of the UN of the stock (± 8.5%) with the UN of the operating emission factors (± 5%) result in the UN of the HFC emissions of ± 10%.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

Recalculations were not necessary because previous years have not been estimated.

[12] Öko-Recherche/Ecofys (Winfried Schwarz and Jochen Harnisch): Establishing the leakage rates of mobile air conditioners (B4-3040/2002/337136/MAR/C1). For the European Commission (DG Environment), April 2003.

Planned improvements (source-specific)

In 2008, the time series 1995-2005 shall be established.

Documentation

Paper documents: Folder 4, sector 9
Electronic documents: Folder 09-14 MAC in general; 09 Passenger Car MAC

2. Trucks

Source category description

In 2006, there were about 71,000 trucks of the weight classes (according to 2002/16/EC) N1, N2, and N3 in traffic register of Estonia, 55% of which are younger than 12 years. In Western Europe systematic air-conditioning of trucks with the refrigerant HFC-134a had started in 1994/95. As a consequence, approx. half the Estonian trucks are potentially air-conditioned. Equipment of these younger vehicles with air-conditioners is relatively high - reaching 90% in case of N3 trucks. The relevant MAC properties (equipment quota, refrigerant charge, leakage rate) depend on truck makes and models. The refrigerant charge of truck MAC systems ranges from 0.65 kg to 1.2 kg, the emission rate is 10-15% depending on the weight class.

Methodological issues

The Estonian Motor Vehicle Registration Centre (ARK) provided a list of all trucks registered at the beginning of 2007, subdivided in weight classes (N1, N2, and N3), makes, models and production years dating back to 1995 and beyond. No official data about air conditioning were available.

As the investigation results had showed congruence between Estonian and German passenger car fleets and their MAC data (based on the high share of imported used vehicles from Germany) the following approach was applied to establish necessary truck MAC data. The German F-gas inventory treats the MAC quotas and charges of certain vehicles (12 truck models altogether) as representatives of their respective weight classes and extrapolates their specific figures to the total N1, N2, and N3 trucks in the country. The same truck models as in Germany were identified in the Estonian truck park for each weight category (N1, N2, N3). The German MAC quotas and refrigerant charges of these representative models were applied to the same models in the Estonian truck fleet. The total values of N1, N2 and N3 trucks in Estonia result from extrapolation of the particular model values pursuant to the share that these models have in the total Estonian fleet, by the three different weight classes N1, N2 and N3.

Method according to IPCC Guidelines 2006: Tier 2a with europe specific determination of EF.

- Country-specific average refrigerant charges: weight class N1: 0.87 kg; weight class N2: 0.88 kg; and weight class N3: 1.1 kg.
- Emission factors[13]: weight class N1: 10%; weight classes N2 and N3: 15%.
- MAC quotas: In the total fleet, the MAC quotas vary by the production years. As the historical quotas 1992-2005 cannot be gathered in 2007, the German values were applied. The relatively high share of German trucks in the Estonian potentially air-conditioned fleet justifies this.

[13] Öko-Recherche (Winfried Schwarz): Establishing the leakage rates of mobile air conditioners in heavy duty vehicles (070501/2005/422963/MAR/C1). Part I trucks, and part II buses, For the European Commission (DG Environment), February 2007.

The total HFC-134a stock in truck MACs in Estonia amounts to 14,934 kg in the year 2006. The HFC-134a emissions from the Estonian truck fleet in 2006 total 1,994 kg (13,4%), the CO_2 equivalent of which is about 2,592 tons.

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts. For the combination of individual uncertainties approach 1 of the 2006 IPCC Guidelines was applied.

The UN of the basic activity data "HFC stock" is estimated ± 8.5%, which is the combination of the individual UN of a) total registrations by weight categories in 2006 (± 1%), b) MAC quotas (± 6%), c) refrigerant charges (± 6%) – with quotas and charges being taken from Germany.

The combination of the UN of the stock (± 8.5%) with the UN of the operating emission factors (± 5%) results in the UN of the HFC emissions of ± 10%.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

Recalculations were not necessary because previous years have not been estimated.

Planned improvements (source-specific)

In 2008, the time series 1995-2005 shall be established.

Documentation

Paper documents: Folder 4, sector 10
Electronic documents: Folder 09-14 MAC in general

3. Buses

Source category description

In 2006, about 2,100 buses were operated in Estonia, 1,200 of which were less than 14 years old (built as of 1992). Equipment of these younger vehicles with air-conditioners is relatively high (approx. 50%). This is because most of them are second-hand vehicles from Western Europe where also most of the few new buses were manufactured. In Western Europe large-scale air-conditioning of buses with the refrigerant HFC-134a had started in 1995 and has reached a high level, now. The relevant MAC properties (equipment quota, refrigerant charge, leakage rate) depend on whether a bus is a city, intercity or a tourist bus. City buses can be subdivided into single and articulated buses; intercity and tourist buses are usually single vehicles, with a small part of tourist buses being double deckers. The refrigerant charge of bus MAC systems is large, ranging from 7 kg to 20 kg, the emission rate is high mainly because of the up to 50 metres long refrigerant piping.

Methodological issues

The Estonian Motor Vehicle Registration Centre (ARK) provided a list of all buses registered at the beginning of 2007 (M3 category), subdivided in makes, models and production years dating back to 1992 and beyond. Data on the city-intercity-tourist bus split were not included, nor are there official data available about air conditioning.

Several big national and local bus operators (TAK, Taisto, SEBE, Hansabuss, GoBus) were interviewed about the MAC data of their own fleet and of the countrywide bus fleet – resulting in two conclusions. Firstly, the shares of the three main bus types are even thirds of the total registrations. Secondly, the average Estonian data on quota, charge, and leakage (refills) largely match the data of Western Europe (see the 2007 bus study for the European Commission[14]) in consequence of the extensive importation of second-hand vehicles from there. In addition, an essential quantity of air-conditioned buses turned out to be manufactured before 1995 so that the decision was made to shift the starting point for the reporting to the years 1992/1993.[15]

Method according to IPCC Guidelines 2006: Tier 2a with country specific determination of EF.

- Country-specific average refrigerant charges: Single buses (city, intercity, tourist): 10 kg; articulated buses and double deckers: 18 kg.
- Country-specific emission factors: Single buses (city, intercity, tourist): 1.5 kg/a; Articulated buses and double deckers: 3 kg/a.
- MAC quotas: In the total fleet, the MAC quotas vary by the production years. As the historical quotas 1992-2005 cannot be gathered in 2008, the

[14] Öko-Recherche (Winfried Schwarz): Establishing the leakage rates of mobile air conditioners in heavy duty vehicles (070501/2005/422963/MAR/C1). Part I trucks, and part II buses, For the European Commission (DG Environment), February 2007.

[15] It was believed that at least the newer of the 120 trolleybuses in Estonia are air-conditioned. This assumption turned out to be wrong. According to the only Estonian operator (TTTK) none of the vehicles is equipped with a MAC.

German values were applied. The high share of German buses in the Estonian fleet justifies this.

The total HFC-134a stock in bus MACs in Estonia amounts to 6,782 kg in the year 2006. The HFC-134a emissions from the Estonian bus fleet in 2006 total 1,039 kg (15.3%), the CO_2 equivalent of which is about 1,350 tons.

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts. For the combination of individual uncertainties approach 1 of the 2006 IPCC Guidelines was applied.

The UN of the basic activity data "HFC stock" is estimated ± 8.7%, which is the combination of the individual UN of a) total registrations in 2006 (± 1%), b) bus split (± 5%), c) MAC quota (± 5%), d) refrigerant charge (± 5%).

The combination of the UN of the stock (± 8.7%) with the UN of the operating emission factor (± 5%) results in the UN of the HFC emissions of ± 10%.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

Recalculations were not necessary because previous years have not been estimated.

Planned improvements (source-specific)

In 2008, the time series 1995-2005 shall be established.

Documentation

Paper documents: Folder 4, sector 11
Electronic documents: Folder 09-14 MAC in general; 11 Bus Air Conditioning

4. Ships

Source category description

Usually, merchant ships >100 Gross Tonnage (GT) are equipped with air-conditioning systems and provision refrigeration, tugs with air-conditioning only, and fishing vessels >18 m with refrigeration. Ship air-conditioning with HFC started from 1996 onwards substituting HCFC-22. In Estonia, 36 ships with air-conditioning are registered. Refrigerants in use are HCFC-22, HFC 407C (mixture), HFC 404A (mixture) and HFC-134a as the new standard refrigerant[16]. By far most HFC-refrigerants are used for air-conditioning (R-134a); only a small part is used for provision cooling (R-134a, R-404A, R-407C). The cooling ad freezing systems of the Estonian deep-sea freezer trawlers operate without HFC (refrigerants: R-22 and ammonia).

Methodological issues

Ships under Estonian flag built in 2000 or later with GT 100 or more and fishing vessels >18 m are listed in the Estonian Ship Register (Estonian Maritime Authority). Data on A/C and provision cooling systems of these ships – except for seven tugboats – were collected from the operating companies, additionally data on all ferries of the two relevant Estonian ferryboat companies – altogether 36 vessels. (The oldest ship with HFC air-conditioning and provision cooling was built in 1968.) The data on type of refrigerant, charge and refilling in 2006 were provided directly by the ship owners. One big ship under Estonian flag was newly built and delivered in 2006 but not built on an Estonian shipyard. Hence, the first HFC refrigerant filling of the A/C system and emissions from this first filling are not reported as activity data for 2006 but are taken into account for the calculation of the HFC-bank in operating systems. The estimation of the stock emissions is based on direct measurement (refilling data 2006).

Method according to IPCC Guidelines 2006: Tier 2a with country specific determination of EF.

- Country-specific HFC refrigerant stock: 6,421 kg R-134a (thereof 110 kg in refrigeration); 521 kg R-404A and 116 kg R-407C (only refrigeration).
- Country-specific stock emissions (refills): 1,315 kg R-134a (EF = 21.1%); 171 kg R-404A (28.9%) and 11 kg 407C (9.5%).

The CO_2 equivalent of the stock emissions (all HFC together) is 2,284 tons.

Uncertainties and time-series consistency

The data on refills are reliable and complete. As a consequence, the uncertainty of the HFC emissions is nevertheless estimated ± 5%, considering that tugboats and naval ships are not yet investigated.

[16] Winfried Schwarz (Öko-Recherche) and Jan-Martin Rhiemeier (Ecofys), The analysis of the emissions of fluorinated greenhouse gases from refrigeration and air conditioning equipment used in the transport sector other than road transport and options for reducing these emissions: Maritime, Rail, and Aircraft Sector. Prepared for the European Commission (07010401/2006/445124/MAR/C4), November 2007.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

Recalculations were not necessary because previous years have not been estimated.

Planned improvements (source-specific)

Tugboats >100 GT are still under investigation as well the Estonian naval ships. In 2008, the time series 1995-2005 shall be established.

Documentation

Paper documents: Folder 4, sector 13
Electronic documents: Folder 09-14 MAC in general; 13 ship AC

5. Railcars

Source category description

In 2006, there were 34 railcars (restaurant cars, sleeping cars, passenger coaches) of the Estonian fleet equipped with a working air conditioner. All systems had been retrofitted from CFC-12, and the refrigerant in use was R-401A. It is a blend containing 13% of HFC-152a by weight, in addition to R-22 (53%) and R-124 (34%); the latter are HCFCs and out of the scope of this report. The relevant MAC properties (refrigerant charge, leakage rate) do not depend on the type of the railcars. The refrigerant charge of railcar MAC systems ranges from 28 kg to 30 kg. The emission rate is high and the losses demand refilling after each arrival at the station in case of the long trips (10 to 17 hrs) between Estonia and Russia.

Methodological issues

Estonian Technical Surveillance Authority (Tehnilise Järelevalve Amet) was contacted to establish the size of the countrywide fleet. For obtaining MAC data all three local rail operators involved in passenger transport (GoRail, Edelaraudtee, Elektriraudtee) and one service company (Ühinenud Depood) were interviewed. The results revealed that there are 34 air-conditioned and regularly maintained railcars. Although usually MAC charges depend on the type of a railcar (dining cars and sleeping cars having much higher charges than coaches) it became evident that this rule does not apply in case of Estonia, the refrigerant charges of MAC systems being around 30 kg in all types of railcars. The refrigerant quantity refilled annually into the railcar stock amounts to 200 kg. This corresponds to the experience of local experts that the MAC systems release 20 grams of refrigerant per operating hour.

Method according to IPCC Guidelines 2006: Tier 2a with country specific determination of EF.

- Country-specific average refrigerant charges: all types of railcars 30 kg/a of R-401A (4.5 kg of HFC-152a).
- Country-specific emission factors: calculation based on annual losses of R-401A (200 kg) and the amount of refrigerant stock leads to the implied emission factor of 0.1961 for all types of railcars.

The total HFC-152a stock in railcar MACs in Estonia amounts to 153 kg in the year 2006. The HFC-152a emissions from the Estonian railcars in 2006 total 30 kg (19,6%), the CO_2 equivalent of which is 4,200 kg based on the GWP 140 of HFC-152a.

There were 95 trams in Estonia, newer ones of these are potentially air-conditioned. However, according to the only Estonian operator (TTTK) none of the vehicles is equipped with a MAC.

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts. For the combination of individual uncertainties approach 1 of the 2006 IPCC Guidelines was applied.

The UN of the basic activity data “HFC stock” is estimated ± 8.5%, which is the combination of the individual UN of a) number of operating vehicles with air conditioning in 2006 (± 0 %), and b) refrigerant charges (± 3%).

The combination of the UN of the stock (± 3%) with the UN of the operating emission factors (± 5%) results in the UN of the HFC emissions of ± 5.8%.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

Recalculations were not necessary because previous years have not been estimated.

Planned improvements (source-specific)

In 2008, the time series 1995-2005 shall be established.

Documentation

Paper documents: Folder 4, sector 14
Electronic documents: Folder 09-14 MAC in general

6. Wheel Tractors and Mobile Machinery

Source category description

First agricultural machines (wheel tractors, combine harvesters) equipped with mobile air conditioners on Estonian market were manufactured in 1997/1998. With regard to construction machines (excavators, loaders) and other mobile machinery (forestry vehicles, roadwork machines) this equipment appeared later, in 2000. Thus only 15% of the 33,000 operating agricultural machines, 32% of the 5,000 construction machines, and 20% of the 1,100 other mobile machines in use in Estonia are potentially air conditioned, in 2006. Air conditioning of these machines is rapidly growing. The equipment quota of the new agricultural machines has reached 75% in recent years. Among new construction and other mobile machines this quota is still lower (40%) but also increasing. The refrigerant in use is HFC-134a. The relevant MAC properties (equipment quota, refrigerant charge, leakage rate) depend on the type and purpose of a specific machine. The refrigerant charge of tractors and mobile machinery MAC systems ranges from 1.0 kg to 2.0 kg. The emission rate is high due to powerful vibration of these machines causing amongst others the connections in the MAC system to become loose.

Methodological issues

The Estonian Motor Vehicle Registration Centre (ARK) published in the yearbook of 2006 the number of wheel tractors and mobile machinery registered in the beginning of 2007. The vehicles were classified according to the production years into 4 categories of up to 2 years, 3 to 5 years, 6 to 10 years, and over 10 years old machines. Official data about air conditioning of the vehicles were not available.

The main seller of agricultural and construction machines on the Estonian market (Mecro) was interviewed about the relevant MAC data. It shows that the average charges and quotas of Estonian agricultural machines match the respective values of Western Europe. The authors of this report taking into account the particularities of the Estonian vehicle fleet estimated the amount of leakages and refills.

Method according to IPCC Guidelines 2006: Tier 2a with country specific determination of EF.

- Country-specific average refrigerant charges: wheel tractors, construction machines, forestry and roadwork machines 1.0 kg/a; combine harvesters: 1.6 kg/a.
- Country-specific emission factors: wheel tractors 20%; combine harvesters, construction machines, forestry and roadwork machines 25%.
- MAC quotas: In the total fleet, the MAC quotas vary by the production years. As the historical quotas of 1997-2005 cannot be gathered in 2007, the values as estimated by the local experts were applied.

In 2006, the total HFC-134a stock in tractor and mobile machinery MACs in Estonia amounts to 4,900 kg in the year 2006. The HFC-134a emissions from

the entire Estonian fleet total 1,030 kg (21%) the CO_2 equivalent of which is about 1,339 tons.

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts. For the combination of individual uncertainties approach 1 of the 2006 IPCC Guidelines was applied.

The UN of the basic activity data "HFC stock" is estimated ± 14.5% for every vehicle type, which is the combination of the individual UN of a) total registrations by vehicle types in 2006 (± 3%), b) MAC quotas (± 10%), c) refrigerant charges (± 10%).

The combination of the UN of the stock (± 14.5%) with the UN of the operating emission factors (± 10 %) results in the UN of the HFC emissions of ± 17.6%.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

Recalculations were not necessary because previous years have not been estimated.

Planned improvements (source-specific)

In 2008, the time series 1995-2005 shall be established.

Documentation

Paper documents: Folder 4, sector 12
Electronic documents: Folder 09-14 MAC in general; 12 Agricultural Machines

2(II).F.2 FOAM BLOWING

This goup which is responsible for about 30.6% of the Estonian F-gas emissions (43.232 Gg CO_2 equivalent) includes PU insulation panels, spray and injection PU foam, PU integral skin foam, XPS insulation foam and One Component PU foam. Data was presented within the NIR 2006.

1. PU Insulation Panels

Source category description

In 2006, HFC blown and containing insulation panels made of polyurethane rigid foam were neither manufactured nor used in Estonia; however, imported products had been applied for several years. In 2001, one Estonian company manufacturing PU sandwich panels (consisting of facings and a rigid polyurethane foam core) had substituted the blowing agent CFC directly by the water/CO_2 reaction. The only manufacturer of industrially prefabricated insulation panels for buildings (some type of sandwich element) combining PU spray foam with polystyrene changed in 2004 from the blowing agent HCFC-141b to CO_2/water and methyl formate. From 1998 onwards, a certain amount of PU sandwich elements manufactured with HFC-134a as blowing agent had been imported from abroad. Although the use of these products in Estonia stopped in 2006, the HFCs enclosed in the foam cells of these panels form a small bank that is a source of emissions in the long run.

Methodological issues

Information on manufacturing in Estonia (no HFC use) was provided by the two aforementioned companies and their (foreign) foam system suppliers. The present bank of HFC-134a as insulating gas in imported sandwich elements had to be assessed by a model because the import/export data from the Estonian customs only indicate origin and total weight of sandwich elements without information on the insulating gases. The model is based on information from the Statistical Board (annual import of sandwich elements minus export), Estonian experts/importers (average quota of imported sandwich elements with PU-core 1998-2001: 15%, 2002-2006: 40%), and foreign manufacturers of sandwich elements (average quota of PU-foam with HFC-134a: 1998/99: 100%, 2000: 50%, 2001: 10%, 2002ff: 5%; PU core: 30% of the sandwich elements weight). As a result, the present bank of HFC containing PU panels (about 760 t) was estimated to contain approx. 230 tons PU with HFC-134a. The HFC-134a content in the foam-stock was estimated at 6.75%.[17]

The annual use-phase HFC-134a emissions from the bank (EF_{op}) are estimated according to experts from manufacturing companies at 0.5% (cf. UBA 2005: 142).

Method according to IPCC Guidelines 2006: Tier 2a with country specific determination of EF.

[17] The panels are manufactured according to experts with 7.5% HFC-134a; after a first year loss (FYL) of 10% during and after manufacturing 6.75% of the blowing agent remain within the foam.

- Country specific EF_{op}: 0.5%.

The Estonian HFC-134a bank in PU insulation panels amounts to 15.38 tons, the annual use-phase emissions are 0,077 tons (100 tons CO_2 equivalent).

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts. For the combination of individual uncertainties approach 1 of the 2006 IPCC Guidelines was applied.

The UN of the basic activity data "HFC stock" is estimated at ± >10% because it is based on both official statistical data and expert judgment.

The combination of the UN of the stock (± >10%) with the UN of the operating emission factor (± 10%) results in the UN of the HFC emissions of ± 15%.

The time series from 1998 to 2005 has not yet been established but can be carried out on the basis of the expert model above mentioned. In 1995 (base-year) HFC emissions from the PU panel application did not yet arise.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

Recalculations were not necessary because previous years have not been estimated.

Planned improvements (source-specific)

In 2008, the time series 1998-2005 shall be established. The use of HFC-134a for sandwich elements shall be revised.

Documentation

Paper documents: Folder 5, sector 15
Electronic documents: Folder 15-18 foams

2. Spray and Injection PU Foam

Source category description

In addition to HFC containing PU sandwich panels, in the 2006 basic investigation HFC-blown injection and spray foam was found. The sector of on-site insulation with spray respectively injection foam blown with the new-developed HFC-365mfc (with HFC-227ea add-on to reduce the flammability) is similarly small. However, there must not only use-phase emissions be considered but also emissions upon manufacturing. The manufacturing emissions are relatively high because the foaming process is an open application. It should be mentioned that HFC-free (water based) PU spray foam systems are also in use, namely for in-site insulation of soil-laid heating pipes, up to some tons/year.

Methodological issues

In the EU, for on-site applied foam the hardly inflammable blowing agent HCFC-141b was no longer permitted as of 2004 at the latest. Difficulties with alternative blowing agents arose from two sides. On the one hand the application of HFC-365mfc is not trivial from a technical point of view. On the other hand the manufacturer of this fluid could not satisfy the demand for HFC-365mfc in 2004 because of problems in his production plant. As a consequence, in the EU the HCFC-141b was still in use after 2004 - according to PU system suppliers also in Estonia.

In Estonia, first for 2006 two companies reported the use (consumption) of HFC-365mfc/HFC-227ea (in addition to a negligible amount of HFC-134a) as blowing agent for on-site applied PU foam. HFC quota in this mixture: HFC-365mfc = 93%, HFC-227ea = 7%.

According to chemical suppliers, the HFC content in the spray foam system before application is 7.5%. On application (manufacturing), a blowing agent loss (EF_{manu}) must be considered which includes two HFC fractions: one released directly upon application and another being released within one year after application. Both fractions together are called first year loss (FYL). The FYL amounts to 20%; 80% of the original blowing agent remain in the foam cells during the use-phase.[18] The product life factor (EF_{op}) is according to chemical suppliers 1%.

Method according to IPCC Guidelines 2006: Tier 2a with country specific determination of EF.

- Country specific EF_{manu}: 20%.
- Country specific EF_{op}: 1%.
- 2006 consumption of HFC containing spray foam: 4,000 kg with content of 300 kg HFC-365mfc/227ea (7.5%).

[18] In contrast to the IPCC guidelines (2006, p. 7.35: FYL 10%), in this report an FYL of 20% is used (Krähling/Solvay 2002: 15% loss on manufacturing, 5% additional loss within the first year).

- Manufacturing emissions (first year): 60 kg HFCs (EF = 20%), thereof 55.8 kg HFC-365mfc and 4.2 kg HFC-227ea, which is 61.8 t CO_2 equivalent. Emissions from the stock did not yet occur.

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts. The UN of the basic activity data "HFC consumption" is estimated at ± >10% because it is based on sales data and expert judgment. The combination of the UN of the consumption (± >10%) with the UN of the manufacturing emission factor (FYL) of ± 10% results in the UN of the HFC emissions of ± 15%.

A time series from 1995 to 2005 cannot be established because 2006 is the first year of HFC use in this application.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

No requirement as 2006 is the first year of HFC use in this application.

Planned improvements (source-specific)

No requirement.

Documentation

Paper documents: Folder 5, sector 15
Electronic documents: Folder 15-18 foams

3. PU Integral Skin Foam

Source category description

In 2006, one company in Estonia used HFC-365mfc for manufacturing of a very small amount of PU integral skin products.

Methodological issues

For manufacturing of PU integral skin foam small quantities (1-2%) of HFC are added as auxiliary blowing agent in order to improve product quality. As integral skin is open-cell foam, upon foaming the blowing agent is released almost completely within one year (according to the industrial foam system supplier, and UBA 2005, p. 144). The EF manu (First Year Loss) is 100%. This means methodologically that there is no need for estimating an HFC bank and operating emissions from this bank. Information on the 2006 consumption of HFC-365mfc was provided by the manufacturer of integral skin products in Estonia, and was confirmed by the foreign foam system supplier. 2006 is the first year the company used HFCs.

Method according to IPCC Guidelines 2006: Tier 2a with country specific determination of EF.

- Country specific EF_{manu}: 100%.
- 2006 consumption and manufacturing emissions of HFC-365mfc: 42 kg, which is 37.4 t CO_2 equivalent (GWP 890).

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts. The UN of the activity and emissions data “HFC consumption” is estimated at only ± 3% because it is based on information of the only user.

A time series from 1995 to 2005 cannot be established because 2006 is the first year of HFC use in this application..

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

No requirement as 2006 is the first year of HFC use in this application.

Planned improvements (source-specific)

No requirement.

Documentation

Paper documents: Folder 5, sector 16
Electronic documents: Folder 15-18 foams; 16 Integral Foam

4. XPS Insulation Foam

Source category description

The 2006 basic research showed that XPS foam is not manufactured in Estonia whereas imported XPS board for thermal insulation is of some importance in the country. The European manufacturers have stepwise shifted from HCFC blowing agents to HFC-134a/152a and to CO_2. The main XPS suppliers to the Estonian market are using CO_2. One international manufacturer currently using both CO_2 and HFC-134a blowing agents supplies the Estonian market from a Scandinavian factory with CO_2 blown foam. From 2001 to 2006, this company sold a considerable amount of HFC-134a containing XPS panels to Estonia where these panels were used. It is generally accepted that in case of HFC-134a some 27% of the blowing agent release to the atmosphere on manufacturing (EF_{manu} = 27%). As a consequence, 73% of the blowing agent remains in the panels as insulating cell gas, in the long term. Thus, in Estonia an HFC bank in the XPS board stock has to be considered as a source of domestic emissions.

Methodological issues

Seven international chemical companies gave data on the XPS foam market in Estonia. Based on this information, both the year-on-year growth in the domestic XPS-foam bank and the HFC content in the annual sales quantities could be assessed for the 2001-2006 periods. From 12.5% (2001) a gradual decrease in the HFC-134a content to 0% (2006) was established, resulting in 5% HFC content of the final 2006 XPS stock (72,000 m^3 XPS, thereof 3,600 m^3 HFC-containing XPS). As the HFC quantity used for the production of one m^3 XPS foam is known (3.3 kg), the HFC bank can be calculated from the volume of XPS sold to Estonia. A use-phase emission factor (EF_{op}) of 0.66% is applied to this long-term bank of enclosed HFC-134a.

- Country specific EF_{op}: 0.66%.
- 2006 HFC-134a bank: 8.7 tons.
- 2006 use-phase emissions: 57.2 kg (0.66%) which is 74.4 t CO_2 equivalent.

Method according to IPCC Guidelines 2006: Tier 2a with country specific determination of EF.

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts.

No official statistical data on the XPS board consumption in Estonia is available. Thus the annual sales and the current stock of XPS foam with HFC-134a had to be calculated with sector experts. The UN of the activity data “HFC stock” is estimated at ± 20%. The uncertainty of the emission factor is estimated 10% so that the UN of the annual use-phase emissions is ± 22.34%

The time series from 2001 to 2005 has not yet been established but can be carried out on the basis of the expert model above mentioned. In 1995 (base-year) HFC emissions from XPS foam did not yet arise.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

Recalculations were not necessary because previous years have not been estimated.

Planned improvements (source-specific)

In 2008, the time series 2001-2005 shall be established.

Documentation

Paper documents: Folder 5, sector 15
Electronic documents: Folder 15-18 foams; 18 XPS Foam

5. One Component PU Foam

Source category description

Estonia is amongst the four biggest EU countries manufacturing polyurethane one-component foam (OCF). To a considerable part, the propellant gases in the foam cans are HFCs (HFC-134a and HFC-152a) that are added to halogen-free flammable gases. By far most of the domestically used fluorinated greenhouse gases (HFCs) are imported for filling million of OCF cans that are, on their part, predominantly exported, especially to Eastern Europe. There is, however, also a considerable domestic market for OCF, which is supplied by both domestic manufacturers and – to lesser degree – foreign companies. The EU F-gas Regulation includes restrictions of the use of HFCs in OCF as of July 2008. This Regulation, however, does not prohibit the production for exportation nor the placing on the market of OCF with HFCs in mixtures if the mixture GWP is less than 150. This means that OCF with HFC-152a can be sold in Estonia without any restrictions also in the future.

Methodological issues

The following data was collected for emission estimation from manufacturing and use of OCF:

- Number of cans (in terms of 750 ml volume) with HFC as blowing agent manufactured in Estonia, average amount of HFC per can, split into HFC-134a and HFC-152a, emissions on filling;
- Number of OCF cans (in terms of 750 ml content) with HFC as blowing agent sold to the Estonian market, HFC split, average amount of HFC propellant per can.

Information sources: The two Estonian companies manufacturing OCF within the country; Estonian companies and main foreign companies selling OCF to the Estonian market; experts from internationally operating companies for PU systems. The share of further ("other") foreign OCF companies selling to the Estonian market was also estimated. The EF_{manu} (1.7%) is based on information from the two domestic manufacturers and was compared to international data. As to the application of OCF, it is assumed that all HFC is emitted from the cans in the year of the OCF use. In contrast to the method of the IPCC Guidelines 1999 and 2006 but in accordance with other submissions under the UNFCCC it is assumed that all use-phase emissions occur in the year of sale (use and disposal occurring promptly after sale). The category "stock 2006" is equated to the HFC content of OFC cans sold to the Estonian market and used in 2006. Hence only emissions from manufacturing and use (= stock) are entered in the CRF table, no emissions from disposal. The 2006 HFC-consumption was in total 714 t.

Method according to IPCC Guidelines 2006: Tier 2a with country specific determination of EF.

- Country specific EF_{manu}: 1.7%.
- Country specific EF_{op}: 100%.

- Manufacturing emissions: 9.6 tons HFC-134a; 2.34 tons HFC-152a; together 12,808 t CO_2 equivalent.
- Stock = use-phase emissions: 22.8 tons HFC-134a; 3.6 tons HFC-152a; together 30,151 t CO_2 equivalent.

The HFC emissions from manufacturing and from stock total to 42,958 t or 42.958 Gg CO_2 equivalent.

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts. As the domestic and foreign manufacturers themselves provided all the relevant data, the data uncertainty is estimated low. The uncertainty of the annual HFC consumption and – consequently – use-phase emissions by quantity and HFC type is ± 15%. The same value applies to the manufacturing emissions.

The time series from 1995 to 2005 has not yet been established. The estimations should be carried out in the course of 2008 or 2009.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

As 2006 is the first year within the F-gas inventory no preceding data could be recalculated.

Planned improvements (source-specific)

In 2008 or 2009, the time series 1995-2005 shall be established.

Documentation

Paper documents: Folder 5, sector 17
Electronic documents: Folder 15-18 foams; 17 OCF

2(II).F.3 FIRE EXTINGUISHERS

In Estonia different types of HFC are used for substituting halons in fire protection (flooding equipment): mostly HFC 227ea (FM-200), the mixture R-866 consisting of HFC-134a, HFC-125 and CO_2, and furthermore HFC-23. The NIR 2006 did not yet present the data. Contribution of the sector to the Estonian F-gas emissions in 2006: ~ 0.5% (0.727 Gg CO_2 equivalent).

Source-category description

F-gases are more expensive than environmentally friendlier substances for fire fighting in indoor flooding systems (e.g. nitrogen, argon). The latter are characterized as overpressure gases. Compared to them, the advantage of F-gases is their lower pressure: The pressure of FM 200 (HFC 227ea) in the piping is about one fifth of the pressure of argon. This makes the F-gases suitable for flooding systems of smaller rooms where the higher pressure of e.g. argon could cause damages. F-gas consumption for fire fighting includes also its usage in military objects.

F-gases for fire fighting are imported to Estonia in closed cylinders. Installation is carried out by connecting the cylinder with the piping system. The cylinder has, according to the supplying companies, no valve outside but only inside so that a mistake upon installation (e.g. opening of the wrong valve) is hardly possible. In case of false alarm or fire the whole charge of the cylinder is blown out. Refilling in situ does normally not take place. Emptied cylinders are replaced by full cylinders. In two cases reported emissions from 2005 and 2006 occurred from false alarm and from accidents on maintenance (0.17 percent of the 2006 stock).

Methodological issues

Data on the amount of the three mentioned HFC-based fluids for fire protection in the 2006 stock was provided directly by six companies dealing with fire protecting systems incl. maintenance and by one supplier of fire fighting agents who submitted the basic data (stock) of eight additional clients. According to experts from these companies no other players were active in this field. The Head of the Fire Safety Department of the Estonian Rescue Board additionally informed about the agents in fixed fire protecting systems reported to the Rescue Board in Estonia up to 2006. The charge of these systems is not known to the Rescue Board. The first HFC installation dates back to 1999. About 22 % of the stock was installed in 2006. Only one company reported on losses resp. emissions (2005, 2006); the other denied such events.

According to IPCC Guidelines 2006 the annual emissions from installed flooding systems are in the range of 2 ± 1 percent of the installed base. As there are no detailed indications on operating emissions from flooding systems in Estonia for a longer period, an EF_{op} of 2% is applied to the bank. Emissions upon filling/refilling (EF_{manu}) are not calculated. According to the long lifetime of flooding systems (15-20 years) and the possibilities of recovery we do not assume end-of-life emissions.

Method according to IPCC guidelines 2006, using IPCC default EF_{op}.

- Operating emission factor EF_{op}: 2%.

In Estonia, the total 2006 quantity of F-gases in installed fire fighting systems amounted to 12.636 t (11.470 t HFC-227ea, 0.137 t HFC-23 and 1.120 t R866, the latter containing 8% CO_2 in mixture with HFC-134a and HFC-125). The emissions from this stock are calculated 2 percent: 2.74 kg HFC-23, 2.2 kg HFC-125, 18.4 kg HFC-134a and 229.4 kg HFC-227ea. The CO_2 equivalent of all 2006 HFC emissions is about 727.4 tons or 0.727 Gg.

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts according to approach 1 of the 2006 IPCC Guidelines.

The data are based on direct information from industry, so that the UN of the data on the different HFC stocks can be estimated comparably low (± 10%). The UN of the emission factor is assessed ± ~10%, so that the combined UN of the emissions is estimated ± 15%.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

As 2006 is the first year of the F-gas inventory no preceding data could be recalculated.

Planned improvements (source-specific)

Establishment of times series; recalculation of emissions.

Documentation

Paper documents: Folder 6, sector 19
Electronic documents: Folder 19 Fire Extinguishers

2(II).F.4 AEROSOLS

This group includes Metered Dose Inhalers (MDI) as well as General and Novelty Aerosols. The NIR 2006 presents the data of MDI only. The sector is responsible for about 2.1% of the Estonian F-gas emissions (3.002 Gg CO_2 equivalent).

1. Metered Dose Inhalers

Under the category of Metered Dose Inhalers (MDI) with HFCs of pharmaceutical grade two aerosol applications are discussed: aerosols for natural medicine and aerosols for the treatment of asthma/COPD (chronic obstructive pulmonary diseases).

Source-category description

Metered Dose Inhalers for natural drugs containing HFC-134a as propellant of pharmaceutical grade are manufactured in Estonia and are partially exported, however not imported; in contrast, all MDIs for asthma/COPD are imported.

Methodological issues

The domestic manufacturer provided the data on manufacturing, domestic consumption and export of MDIs for natural drug products including the emissions rate from manufacturing (EF_{manu} = 3 %). Use-phase emissions: The number of MDIs for both natural and anti-asthma drugs sold to the domestic market in 2006 (production + import - export) is the stock of the same year 2006. (A surcharge factor for hospitals and doctors' samples of 5% is applied.) As the consumption of the products follows the purchase immediately, annual stock and the annual emissions are the same size. HFC-134a is completely exhaled after inhalation so that 100% is the appropriate value for the use-phase emission factor.

In 2006 MDIs (asthma/COPD) with HFC-134a as propellant were registered in Estonia from six companies, but only three companies put their products on the market. Detailed information and sales figures on the various pharmaceutical products and on the HFC content per device were provided by the Estonian Medical Board (RAVIMIAMET) and were controlled by means of information from the respective companies.

Method according to IPCC guidelines 2006: Tier 2a with country specific EF.

- Country specific EF_{manu}: 3%.
- Country specific EF_{op}: 100%.
- Natural MDIs: The 2006 domestic consumption of HFC-134a was 2.02 tons (manufacturing emissions: 61 kg), of which 1.37 tons were sold to the domestic market, resulting in use-phase emissions of the same amount (1.37 tons).
- Anti-Asthma MDIs: The 2006 domestic market was 789 kg, with the same quantity of emissions.

Overall emissions: 2.22 tons HFC-134a or 2,886 tons CO_2 equivalent (2.886 Gg).

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts according to approach 1 of the 2006 IPCC Guidelines.

The data are based on direct information from manufacturers and from trade departments in industry, so that the activity data domestic production and domestic market are deemed highly reliable. As a consequence, the UN of the emissions (manufacturing and use-phase) is estimated ± 10%.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

As 2006 is the first year of the F-gas inventory no preceding data could be recalculated.

Planned improvements (source-specific)

Establishment of time series.

Documentation

Paper documents: Folder 6, sector 20
Electronic documents: Folder 20 Fire Extinguishers

2. General and Novelty Aerosols

Source-category description

HFC-134a is used as propellant in some technical aerosols like solvent and cleaning sprays and in novelty aerosols such as signal horns for sport events or hunting. The signal horns are manufactured in Estonia, solvent and cleaning sprays with HFC-134a are imported.

Methodological issues

The Estonian manufacturer of signal horns provided data on his HFC-134a consumption for signal horns sold to the Estonian market in 2006; manufacturers from US and Germany submitted the respective data on solvent and cleaning sprays sold to Estonia. They also informed on application areas (metal cleaning; cleaning up of fresh polyurethane foam; cleaning of MAC-filters), on the number of cans and the content of HFC-134a per can. The number of cans for all purposes with HFC charge between 11 and 90 g/can was approx. 2,700; the HFC-134a charge totalled 89.4 kg (average charge 32.8 g/can).

As in MDIs, the HFC-consumption for general aerosols in 2006 is equated to emission in the same year 2006 (EF_{op} 100%). The very small amount of emissions from manufacturing in case of the signal horns is included.

Method according to IPCC guidelines 2006: Tier 2a with country specific EF.

- Country specific charge of aerosol cans: 32.8 g
- Country specific operating emission factor: 100%

The total 2006 amount of HFC-134a emissions from general and novelty aerosols is 89.4 kg, representing 116.2 tons CO_2 equivalent (0.116 Gg).

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts according to approach 1 of the 2006 IPCC Guidelines.

The data are based on direct information from industry, so that the UN of the activity data on the number of units and on charges can be estimated low (± 10%). The same UN value applies to the emissions because the emission factor is 100%.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

As 2006 is the first year of the F-gas inventory no preceding data could be recalculated.

Planned improvements (source-specific)

Establishment of time series.

Documentation

Paper documents: Folder 6, sector 21/22, 38/39
Electronic documents: Folder 21 General Aerosols; 23 solvents

2(II).F.7 ELECTRICAL EQUIPMENT FOR TRANSMISSION OF ELECTRICITY

Electrical equipment for electrical power transmission and distribution is the largest individual SF_6 consumption sector in Estonia. Already reported within the NIR 2006. The sector's contribution to the Estonian F-gas emissions: almost 0.6% (0.771 Gg CO_2-equivalent).

Source-category description

SF_6 is used as an arc quenching and insulating gas in high-voltage (110-380 kV) and medium-voltage (6-35 kV) switchgear (GIS) and control gear. In Estonia the use of SF_6 in this sector started in 1988 (high-voltage) and 1999 (medium-voltage), respectively. The equipment is not manufactured within the country. Medium-voltage GIS (distribution equipment) operate with low over-pressure and little gas quantities of only some kg/system. They are already SF_6 charged when imported and are hermetically closed ("sealed for life"). High-voltage GIS (transmission equipment) with a higher operating pressure (up to 7 bar) and bigger gas quantities ("closed for life") have to be replenished in their lifetime. They are imported with a transport filling and are filled up in site (on site erection).

Methodological issues

Three Estonian companies of electrical power distribution operate SF_6 containing HV-GIS (two companies) and MV-GIS (two companies). The companies provided data on their equipment, on their SF_6 consumption in total and on refilling during the last years. The third company, Estonian Railway, operates several own MV-GIS. 95% of the SF_6 stock is concentrated at the main power distributor of the country. Another user of a small SF_6 quantity (142 kg stock in 2006) has not yet reported detailed data, for which reason his emissions could not yet be determined. The refilling data of the HV equipment reported from different power suppliers ranged from 0.1% to 0.7%/year. In case of MV-GIS no losses occurred according to the companies. The main operator of HV-GIS estimated the EF_{manu} (topping up of imported HV-GIS within the country) 0.1%. The EF_{op} of HV- and MV-GIS used in this report is based on the default emission factors of the IPCC Guidelines 2006 with 0.7% (high voltage) and 0.1% (medium voltage) per year, respectively.

Method according to IPCC guidelines 2006: Tier 3.

- Country specific EF_{manu} (manufacturing emission factor, on site erection): 0.1%.
- EF_{op} (according to IPCC GL): 0.7% (HV), 0.1% (MV).

Manufacturing emissions is 0.52 kg. The respective stock amounts to 4,227.2 kg (HV) and 2,141.9 kg (MV). Stock emissions: 29.6 kg (HV), 2.14 kg (MV). Total: 31.73 kg.

Total global warming emissions: 771 t CO_2 equivalent (0.771 Gg).

Uncertainties and time-series consistency

Öko-Recherche experts assessed the emissions uncertainty (UN) pursuant to approach 1 of the 2006 IPCC Guidelines. As the activity data are based on direct information from industry, their UN is estimated low: ± 3%. The UN of the default emission factors is ± 10% (IPCC GL 2006, Tier 3). The combined UN of the emissions is ± ~10.4%.

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

Recalculations were not necessary because previous years have not been estimated.

Planned improvements (source-specific)

The data of the missing operator shall be collected. Establishment of time series.

Documentation

Paper documents: Folder 7, sector 28
Electronic documents: Folder 28 SF6 switchgear

2(II).F.8 OTHER ELECTRICAL EQUIPMENT

Under "Other Electrical Equipment" use and emissions of SF_6 from radiotherapy devices are reported. Already reported within the NIR 2006. The sector's contribution to the Estonian F-gas emissions is marginal (0.02%, 0.029 Gg CO_2-equivalent).

Source-category description

Two hospitals in Estonia use SF_6 insulated radiotherapy equipment (oncology). The two devices are of different size. Other applications – e.g. SF_6 insulated particle accelerators or gas impregnation of power capacitors – do not occur in Estonia.

Methodological issues

Data on charge and use-phase losses were directly submitted from the medical operator. The operator calculated the emission rate of the one operating system at 10% a year (a 2006 newly installed modern system). Incase of the smaller and much elder system the EF_{op} was calculated at 30% a year, bases on the operator's experience from the last four years. The country specific EF_{op} deduced from this information is 12.2

Method according to IPCC guidelines 2006: Tier 2a with country specific EF.

- Country specific EF_{op}: 12.2.

The 2006 stock of SF_6 totals 10 kg, the 2006 operating emissions 1.2 kg.

Global warming emissions: 28.7 t CO_2 equivalent (0.0287 Gg).

Uncertainties and time-series consistency

The data are based on estimation of the operators. The emissions uncertainty is estimated +- 30%

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

Recalculations were not necessary because previous years have not been estimated.

Planned improvements (source-specific)

Establishment of time series.

Documentation

Paper documents: Folder 7, sector 36+41
Electronic documents: Folder 36 Particle Accelerators and radiotherapy

2(II).F.9c SPORT SHOE SOLES

Under this title SF_6 and PFC emissions from sport shoes with gas cushion are reported. The NIR 2006 did not yet present the data. Contribution to Estonia's F-gas emissions in 2006: ~ 0.3% (0.433 Gg CO_2 equivalent).

Source-category description

Sport shoes using soles with SF_6-gas cushions were introduced to the European market in the early 1990's. From 2003 to 2005 SF_6 was replaced by PFC-218 (perfluoropropane). Footwear with HFC/PFC-cushions has not been manufactured in Estonia but was imported. 100 percent of the F-gases in the soles are emitted at the end-of-life of the shoes. The lifetime is calculated at three years.

Methodological issues

Data on the Estonian market of sport shoes with SF_6 or PFC gas cushions were provided by the manufacturer. New footwear on the Estonian market has been clear of SF_6 from July 2003 onwards; final disposal emissions occurred in 2006; PFC-stock, PFC quantity for disposal/PFC disposal emissions have to be calculated for 2004-2006, and 2006-2009, respectively.

The method follows IPCC guidelines 2006 (Emissions in year t = Sales in year t-3).

- $EF_{disposal}$: 100% (IPCC GL).

The total 2006 quantity of SF_6 in footwear at decommissioning (end of life emission) amounts to 15 kg and of PFC-218 to 10.7 kg. The CO_2 equivalent emissions are 358.5 t, and 74.9 t, respectively, in total 433.4 t CO_2 equivalent (0.4334 Gg).

Uncertainties and time-series consistency

The emissions uncertainty (UN) was assessed by the Öko-Recherche experts according to approach 1 of the 2006 IPCC Guidelines.

The data are based on direct information from industry, so that the UN of the activity data "sales in year 2003" and "emissions in 2006" can be estimated comparably low (± 10%).

So far, time series from 1995 onwards have not been established because 2006 is the first and only year in Estonian F-gas emission inventory.

Source-specific quality assurance/quality control and verification

The data for this report was collected within the framework of the Twinning Project EE2005/IB/EN/01. QC by the data collecting expert and co-operators.

Source-specific recalculations

As 2006 is the first year of the F-gas inventory no preceding data could be recalculated.

Planned improvements (source-specific)

Establishment of times series.

Documentation

Paper documents: Folder 7, sector 35
Electronic documents: Folder 35 Sport Shoe Soles