5 SOLVENT AND OTHER PRODUCT USE (CRF SECTOR 3)

5.1 Sector Overview

This chapter describes the methodology used for calculating greenhouse gas emissions from solvent use in Austria. Solvents are chemical compounds, which are used to dissolve substances as paint, glues, ink, rubber, plastic, pesticides or for cleaning purposes (degreasing). After application of these substances or other procedures of solvent use most of the solvents are released into air. Because solvents consist mainly of NMVOC, solvent use is a major source for anthropogenic NMVOC emissions in Austria. Once released into the atmosphere NMVOCs react with reactive molecules (mainly HO-radicals) or high energetic light to finally form CO_2.

Estimations for N_2O emissions from other product use (anaesthesia and aerosol cans) are also addressed in this chapter.

5.1.1 Emission Trends

In the year 2008, 0.4% of total GHG emissions in Austria (388 Gg CO_2 equivalents) originated from *Solvent and Other Product Use*. 60% of these emissions were indirect CO_2 emissions, 40% were accounted for by N_2O emissions.

Figure 16 and Table 122 present the trend in total greenhouse gas emissions by subcategories.

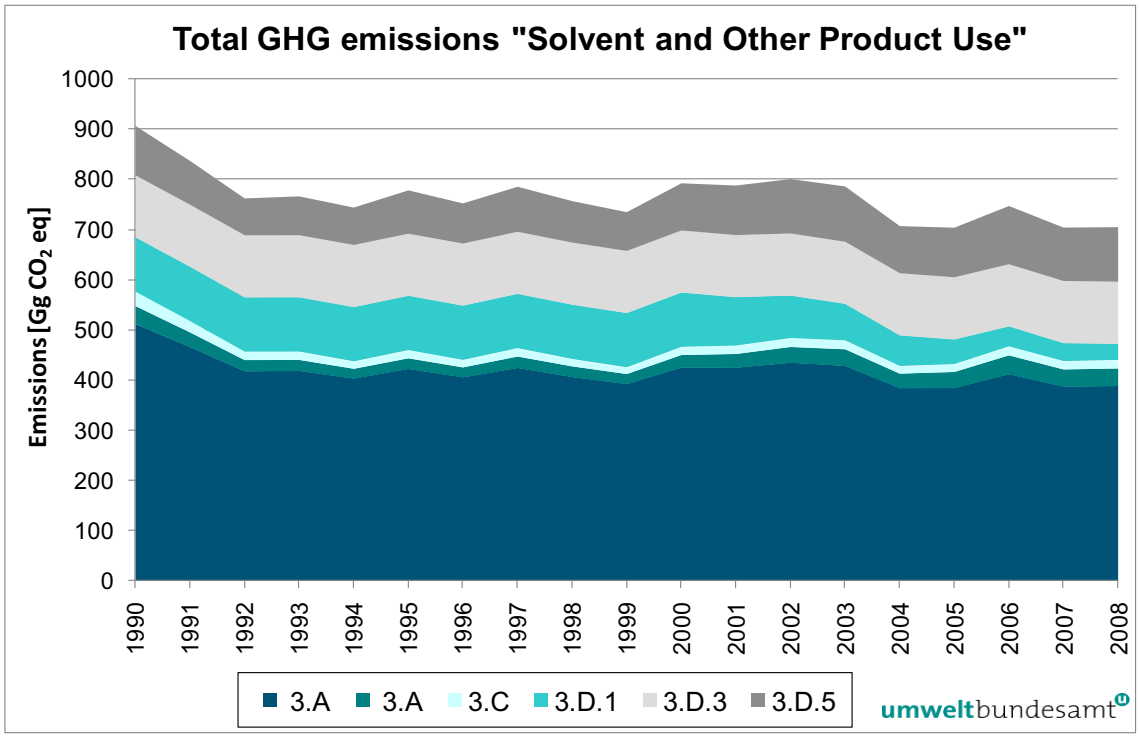

Figure 16: Total greenhouse gas emissions and trend from 1990–2008 by subcategories of Category 3 Solvent and Other Product Use.

Table 122: Total greenhouse gas emissions and trend from 1990–2008 by subcategories of Category 3 Solvent and Other Product Use.

GHG	Total 3	3.A	3.B	3.C	3.D	3.D.1	3.D.3	3.D.5
		Solvent	*Solvent*	*Solvent*		*Use of N_2O*	*Use of N_2O*	*Solvent*
				[Gg CO_2 equivalent]				
1990	511.80	117.70	35.51	27.94	330.65	108.50	124.00	98.15
1991	465.98	95.63	29.10	21.55	319.71	108.50	124.00	87.21
1992	417.65	73.70	22.63	15.48	305.84	108.50	124.00	73.34
1993	418.48	71.30	22.11	15.27	309.80	108.50	124.00	77.30
1994	403.26	63.13	19.79	13.37	306.97	108.50	124.00	74.47
1995	422.45	67.29	21.33	15.08	318.76	108.50	124.00	86.26
1996	405.66	59.65	20.12	13.48	312.41	108.50	124.00	79.91
1997	424.37	63.96	22.94	15.41	322.07	108.50	124.00	89.57
1998	406.32	56.38	21.49	13.38	315.08	108.50	124.00	82.58
1999	392.26	50.33	20.38	11.91	309.63	108.50	124.00	77.13
2000	425.12	58.52	25.17	15.03	326.40	108.50	124.00	93.90
2001	424.82	62.37	27.55	15.47	319.43	96.72	124.00	98.71
2002	434.79	69.41	31.45	16.63	317.30	84.94	124.00	108.36
2003	428.48	71.50	33.20	16.52	307.25	73.16	124.00	110.09
2004	384.10	61.78	29.38	13.76	279.19	61.38	124.00	93.81
2005	384.65	65.98	32.10	14.15	272.42	49.60	124.00	98.82
2006	411.97	77.43	37.67	16.60	280.26	40.30	124.00	115.96
2007	387.23	70.96	34.52	15.22	266.54	36.27	124.00	106.27
2008	388.41	72.49	35.27	15.54	265.11	32.55	124.00	108.56
Trend 2007–2008	0.3%	2.2%	2.2%	2.2%	-0.5%	-10.3%	0.0%	2.2%
Trend 1990-2008	-24.1%	-38.4%	-0.7%	-44.4%	-19.8%	-70.0%	0.0%	10.6%

Greenhouse gas emissions in this sector decreased by 24% between 1990 and 2008, due to decreasing solvent and N_2O use as well as due to the positive impact of the enforced laws and regulations in Austria:

- Solvent Ordinance: limitation of emission of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products in order to combat acidification and ground-level ozone

  Federal Law Gazette II No. 398/2005[36], amendment of Federal Law Gazette 872/1995[37]; amendment of Federal Law Gazette 492/1991[38] (implementation of Council Directive 2004/42/CE)

[36] Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über die Begrenzung der Emissionen flüchtiger organischer Verbindungen durch Beschränkung des Inverkehrsetzens und der Verwendung organischer Lösungsmittel in bestimmten Farben und Lacken (Lösungsmittelverordnung 2005 – LMV 2005), BGBl. II Nr. 398/2005; Umsetzung der Richtlinie 2004/42/EG

- Ordinance for paint finishing system (surface technology systems): limitation of emission of volatile organic compounds due to the use of organic solvents by activities such as surface coating, painting or varnishing of different materials and products along the entire chain in the painting process in order to combat acidification and ground-level ozone

  Federal Law Gazette 873/1995[39], amendment of Federal Law Gazette 27/1990[40]
- Federal Ozone Law: establishes by various measures a reduction in emissions of ozone precursors NO_x and NMVOC

  Federal Law Gazette 309/199, amendment of Federal Law Gazette 210/1992[41]
- Ordinance for industrial facilities and installations applying chlorinated hydrocarbon: for limitation of emission of chlorinated organic solvents from industrial facilities and installations applying chlorinated hydrocarbon

  Federal Law Gazette 865/1994[42]
- Convention on Long-range Transboundary Air Pollution (LRTAP)[43], extended by eight protocols from which the following have relevance
  - The 1988 Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes[44]
  - The 1991 Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes[45]
  - The 1998 Protocol on Persistent Organic Pollutants (POPs)[46]
  - The 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone; 21 Parties.[47]

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[37] Verordnung des Bundesministers für Umwelt über Verbote und Beschränkungen von organischen Lösungsmitteln (Lösungsmittelverordnung 1995 – LMVO 1995), BGBl 872/1995

[38] Verordnung des Bundesministers für Umwelt, Jugend und Familie über Verbote und Beschränkungen von organischen Lösungsmitteln (Lösungsmittelverordnung), BGBl. Nr. 492/1991

[39] Verordnung des Bundesministers für wirtschaftliche Angelegenheiten über die Begrenzung der Emission von luftverunreinigenden Stoffen aus Lackieranlagen in gewerblichen Betriebsanlagen (Lackieranlagen-Verordnung), BGBl. Nr. 873/1995

[40] Verordnung des Bundesministers für wirtschaftliche Angelegenheiten vom 26. April 1989 über die Begrenzung der Emission von chlorierten organischen Lösemitteln aus CKW-Anlagen in gewerblichen Betriebsanlagen (CKW-Anlagen-Verordnung), BGBl. Nr. 27/1990

[41] Bundesgesetz über Maßnahmen zur Abwehr der Ozonbelastung und die Information der Bevölkerung über hohe Ozonbelastungen, mit dem das Smogalarmgesetz, BGBl. Nr. 38/1989, geändert wird (Ozongesetz)

[42] Verordnung des Bundesministers für wirtschaftliche Angelegenheiten über die Begrenzung der Emission von chlorierten organischen Lösemitteln aus CKW-Anlagen in gewerblichen Betriebsanlagen (CKW-Anlagen-Verordnung 1994), BGBl. Nr. 865/1994

[43] Entered into force 14 February 1991; ratified by Austria 16 December 1982; See for more information UMWELTBUNDESAMT (2009): Informative Inventory Report. Vienna.

[44] Entered into force 14 February 1991; ratified by Austria 15 January 1990; BGBl. Nr. 273/1991

[45] Entered into force 29 September 1997; ratified by Austria 23 August 1994; Bekämpfung von Emissionen flüchtiger organischer Verbindungen oder ihres grenzüberschreitenden Flusses samt Anhängen und Erklärung, BGBl. III Nr. 164/1997

[46] Entered into force on 23 October 2003; ratified by Austria 27 August 2002

[47] Entered into force on 17 May 2005; signed by Austria 1 December 2000

- Ordinance for volatile organic compounds (VOC) due to the use of organic solvents in certain activities and installations;

  Federal Law Gazette II No. 301/2002[48], amended by Federal Law Gazette[49]
- Council Directive 1999/13/EC[50] of March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations
- Council Directive 2004/42/CE[51] of the European Parliament and of the Council of 21 April 2004 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC
- Ordinance on the limitation of emission during the use of solvents containing lightly volatile halogenated hydrocarbons in industrial facilities and installations

  Federal Law Gazette II No. 411/2005[52]

In emission intensive activity areas such as coating, painting, and printing as well as in the pharmaceutical industry several measures were implemented:

- Primary measures
  - complete substitution of certain solvents
  - Reduction of the solvent content by changing the composition of solvent containing products
  - technological change from solvent emitting processes to low or non-solvent emitting processes
  - implementation of resources saving procedures and techniques
  - installation of new equipments and facilities and shutdown of old equipments and facilities
  - avoidance of fugitive emissions
- Secondary measures
  - Waste gas collection and waste gas purification, whereas the solvents in the exhaust air are precipitated and either recycled if applicable or destructed.
  - raising of environmental awareness
  - compliance with emission limit values for exhaust gas
  - compilation of solvent balance
  - compilation of solvent reduction plan

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[48] Verordnung des Bundesministers für Wirtschaft und Arbeit zur Umsetzung der Richtlinie 1999/13/EG über die Begrenzung der Emissionen bei der Verwendung organischer Lösungsmittel in gewerblichen Betriebsanlagen (VOC-Anlagen-Verordnung – VAV) BGBL II Nr. 301/2002

[49] Änderung der VOC-Anlagen-Verordnung – VAV, BGBl. II Nr. 42/2005

[50] Richtlinie 1999/13/EG des Rates vom 11. März 1999 über die Begrenzung von Emissionen flüchtiger organischer Verbindungen, die bei bestimmten Tätigkeiten und in bestimmten Anlagen bei der Verwendung organischer Lösungsmittel entstehen

[51] Richtlinie 2004/42/EG des Europäischen Rates vom 21. April 2004 über die Begrenzung von Emissionen flüchtiger organischer Verbindungen aufgrund der Verwendung organischer Lösemittel in bestimmten Farben und Lacken und in Produkten der Fahrzeugreparaturlackierung sowie zur Änderung der Richtlinie 1999/13/EG

[52] Verordnung des Bundesministers für Wirtschaft und Arbeit über die Begrenzung der Emissionen bei der Verwendung halogenierter organischer Lösungsmittel in gewerblichen Betriebsanlagen (HKW-Anlagen-Verordnung – HAV) BGBl. II Nr. 411/2005

But also the N_2O use has significantly decreased due to shorter duration of anaesthesia during operations and more regional anaesthetics than general anaesthesia.

Table 123 presents the trend in total greenhouse gas emissions by gas.

Table 123:Trend in greenhouse gas emissions of solvent and other product use 1990–2008.

GHG	CO_2 emission [Gg CO_2 equivalent]	N_2O emission [Gg CO_2 equivalent]	Total [Gg CO_2 equivalent]
1990	279.30	232.50	511.80
1991	233.48	232.50	465.98
1992	185.15	232.50	417.65
1993	185.98	232.50	418.48
1994	170.76	232.50	403.26
1995	189.95	232.50	422.45
1996	173.16	232.50	405.66
1997	191.87	232.50	424.37
1998	173.82	232.50	406.32
1999	159.76	232.50	392.26
2000	192.62	232.50	425.12
2001	204.10	220.72	424.82
2002	225.85	208.94	434.79
2003	231.32	197.16	428.48
2004	198.72	185.38	384.10
2005	211.05	173.60	384.65
2006	247.67	164.30	411.97
2007	226.96	160.27	387.23
2008	231.86	156.55	388.41
Trend 2007–2008	2.2%	-2.3%	0.3%
Trend 1990-2008	-17.0%	-32.7%	-24.1%

5.1.2 Key Sources

The key category analysis is presented in Chapter 1.5. This chapter includes information about the key sources in the solvents sector. CO_2 emissions of this source have been identified as key category.

Table 124:Key sources of solvent and other product use.

IPCC Category	Source Categories	Key Sources*	
		GHG	KS-Assessment
3	Solvent and other product use	CO_2	LA 90 / TA 08

LA90 = Level Assessment 1990; LA90 = Level Assessment 2008

5.1.3 Completeness

Table 125 gives an overview of the IPCC categories included in this chapter and presents the transformation matrix from SNAP categories. It also provides information on the status of emission estimates of all subcategories. A "✓" indicates that emissions from this sub-category have been estimated.

Table 125:Overview of subcategories of solvents and other product use: transformation into SNAP Codes and status of estimation.

IPCC Category		SNAP		CO_2	N_2O
3.A	Paint application	0601	Paint application	✓	NA
3.B	Degreasing and Dry Cleaning	0602	Degreasing, dry cleaning and electronics	✓	NA
3.C	Chemical Products, Manufacture and Processing	0603	Chemical products manufacturing and processing	✓	NA
3.D	Other	0604	Other use of solvents and related activities	✓	NA
		0605	Use of HFC, N2O, NH3, PFC and SF6	NA	✓

5.2 CO_2 Emissions from Solvent and other product use (Category 3.A, 3.B, 3.C and 3.D.5)

5.2.1 Methodology Overview

CO_2 emissions from solvent use were calculated from NMVOC emissions of this sector. As a first step the quantity of solvents used and the solvent emissions were calculated.

To determine the quantity of solvents used in Austria in the various applications, a bottom up and a top down approach were combined. Figure 17 to Figure 19 present an overview of the methodology.

The top down approach provided total quantities of solvents used in Austria. The share of the solvents used for the different applications and the solvent emission factors have been calculated on the basis of the bottom up approach. By linking the results of bottom up and top down approach, quantities of solvents annually used and solvent emissions for the different applications were obtained.

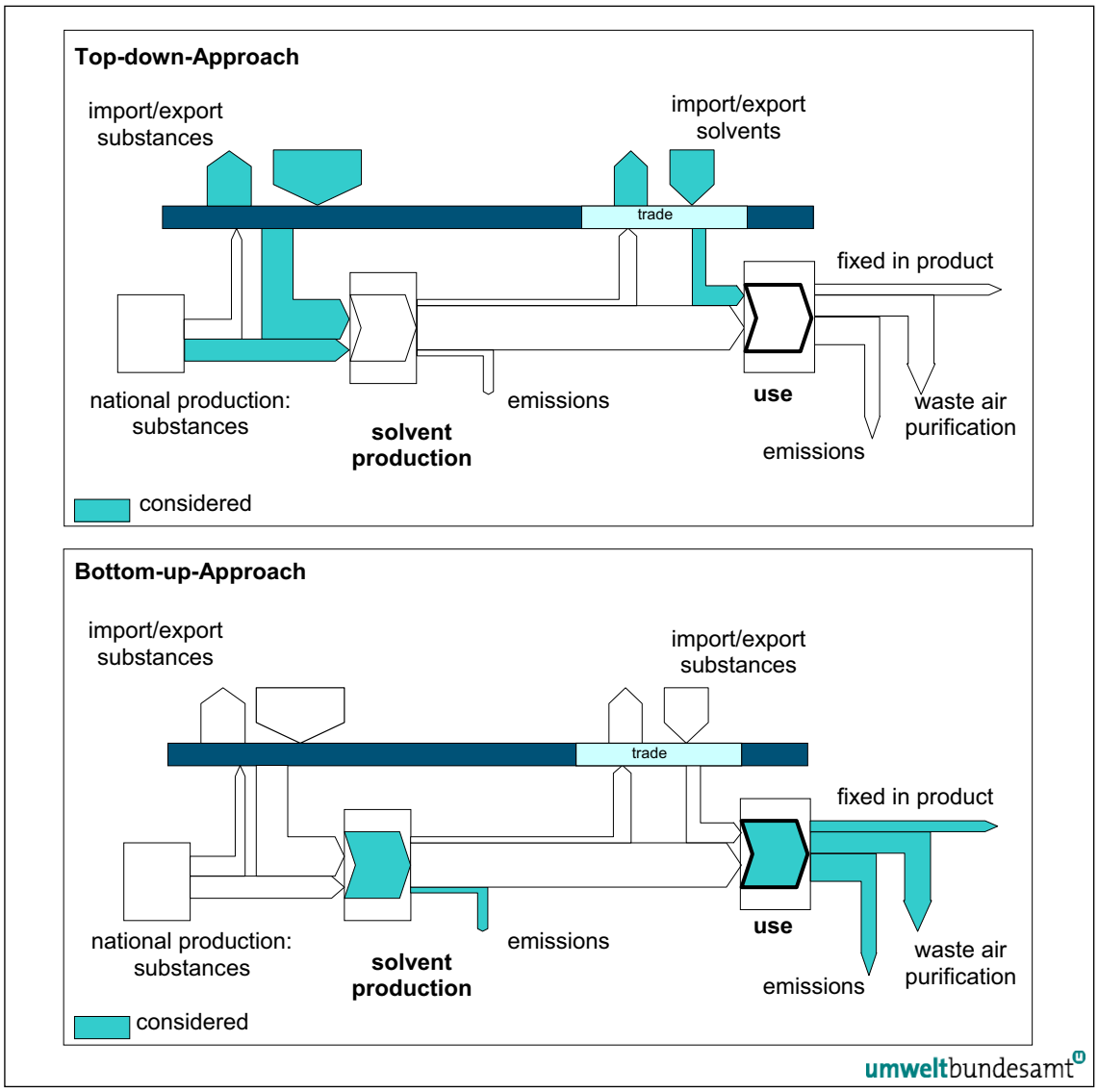

Figure 17: Top-down-Approach compared to Bottom-up-Approach.

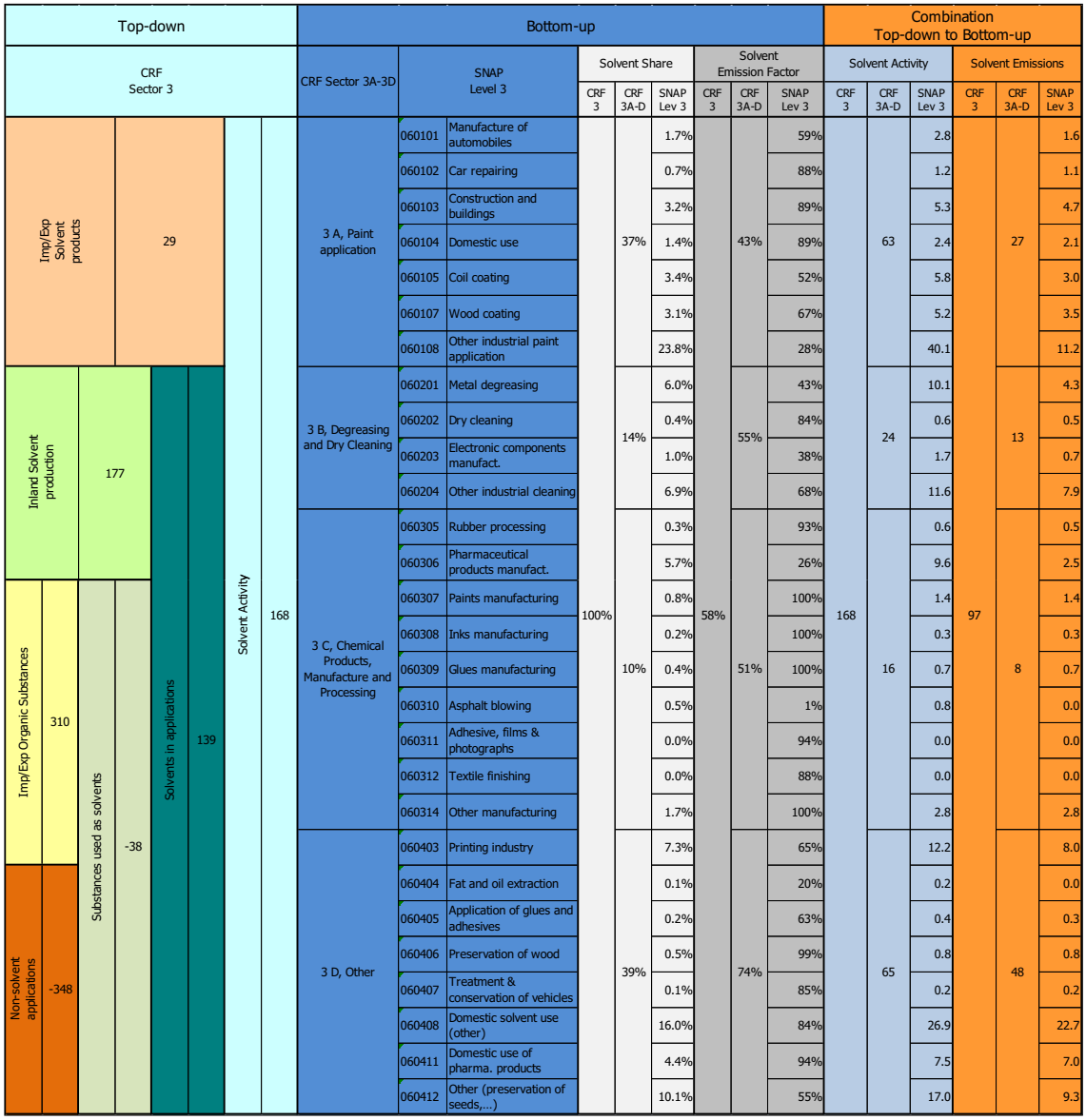

Figure 18: Combination of Top-down-Approach compared to Bottom-up-Approach for 2008 (in Gg).

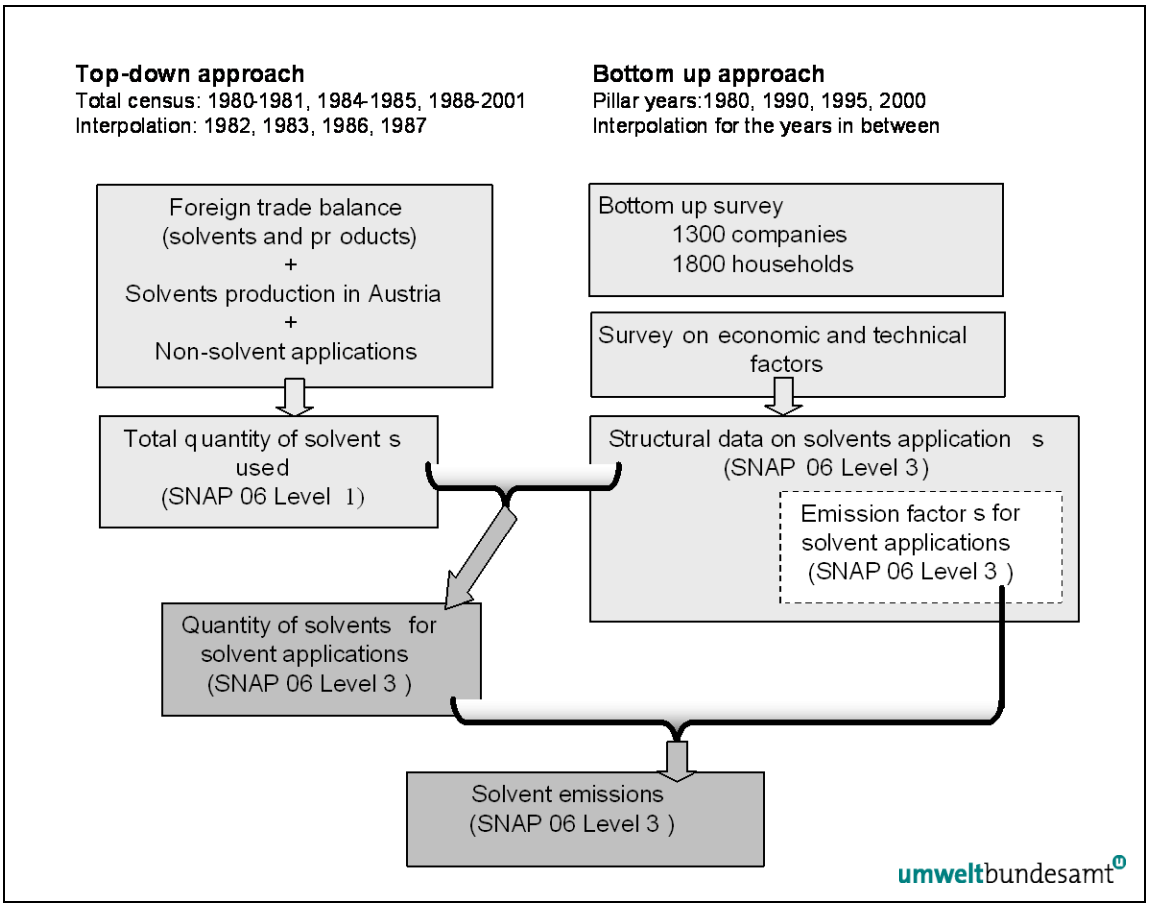

Figure 19: Overview of the methodology for solvent emissions.

A study (WINDSPERGER et al. 2002a) showed that emission estimates only based on the top down approach overestimate emissions because a large amount of solvent substances is used for "non-solvent-applications". "Non-solvent application" are applications where substances usually are used as feed stock in chemical, pharmaceutical or petrochemical industry (e.g. production of MTBE[53], ETBE[54], formaldehyde, polyester, biodiesel, pharmaceuticals etc.) and where therefore no emissions from "solvent use" arise. However, there might be emissions from the use of the produced products, such as MTBE and ETBE which is used as fuel additive and finally combusted, these emissions for example are considered in the transport sector.

Additionally the comparison of the top-down and the bottom-up approach helped to identify several quantitatively important applications like windscreens wiper fluids, antifreeze, moonlighting, hospitals, deicing agents of aeroplanes, tourism, cement- respectively pulp industry, which were not considered in the top-down approach.

[53] Methyl-tertiär-butylether

[54] Ethyl-*tert*-butylether

5.2.2 Top-down Approach

The top-down approach is based on

1. import-export statistics (foreign trade balance)
2. production statistics on solvents in Austria
3. a survey on non-solvent-applications in companies (WINDSPERGER et al. 2004a, WINDSPERGER et al. 2008)
4. survey on the solvent content in products and preparations at producers and retailers (WINDSPERGER et al. 2002a, WINDSPERGER et al. 2008)

ad (1) and (2): Total quantity of solvents used in Austria were obtained from import-export statistics and production statistics provided by STATISTIK AUSTRIA.

Nearly a full top down investigation of substances of the import-export statistics from 1980 to 2007 was carried out (data in the years 1982, 1983, 1986 and 1987 were linearly interpolated). A main problem was that the methodology of the import-export statistics changed over the years. In earlier years products and substances had been pooled to groups and whereas the current foreign trade balance is more detailed with regard to products and substances. It was necessary to harmonise the time series in case of deviations.

There are only a few facilities producing solvents in Austria. Therefore due to confidentiality the Statistic Austria provided the data in an aggregated form. The solvents production fluctuated especially in the last years considerably.

ad (3): In the study on the comparison of top down and bottom up approach (WINDSPERGER et al. 2002a) the amount of solvent substances used in "non-solvent-applications" was identified. The 20 most important companies in this context were identified and asked to report the quantities of solvents they used over the considered time period in „non-solvent-applications"." In 2008 these companies were requested to report the quantities of used solvents for the time period 2002-2007 in „non-solvent-applications".

ad (4): Relevant producers and retailers provided data on solvent content in products and preparations. As the most important substance groups alcohols and esters were identified.

5.2.3 Bottom-up Approach

In a first step an extensive survey on the use of solvents in the year 2000 was carried out in 1 300 Austrian companies (WINDSPERGER et al. 2002b). In this survey data about the solvent content of paints, cleaning agents etc. and on solvents used (both substances and substance categories) like acetone or alcohols were collected.

Furthermore information were gathered about

- type of application of the solvents
  - final application
  - cleaner
  - product preparation
- type of waste gas treatment
  - open application
  - waste gas collection
  - waste gas treatment.

For every category of application and waste gas treatment an emission factor was estimated to calculate solvent emissions in the year 2000 (see Table 126).

Table 126:Emission factors for NMVOC emissions from Solvent Use.

Category	Factor
final application	1.00
cleaner	0.85
product preparation	0.05
open application	1.00
waste gas collection	0.50
waste gas treatment	0.20

The above mentioned survey was carried out at all industrial branches with solvent applications, results for solvent use per substance category were collected at NACE-level-4. The total amounts of solvents used per industrial branch were extrapolated using the number of employees (the values of "solvent use per employee" of the sample was multiplied by total employment of the relevant branches taken from national employment statistics (STATISTIK AUSTRIA 2000 & 1998) and using information from (KSV1870 INFORMATION, 2000).

For three pillar years (1980, 1990, 1995) the values for solvent use were extrapolated using the factor "solvent use per employee" of the year 2000 and the number of employees of the respective year taken from national statistics (Statistik Austria 2001)(WINDSPERGER et al. 2004a). For the pillar year 2005 the structural business statistics (number of employees (NACE Rev.1.1)) were taken from (EUROSTAT 2008).

In a second step a survey in 1 800 households was made (WINDSPERGER et al. 2002a) for estimating the domestic solvent use (37 categories in 5 main groups: cosmetic, do-it-yourself, household cleaning, car, fauna and flora). Also, solvent use in the context of moonlighting besides commercial work and do-it-yourself was calculated.

The comparison of top down and bottom up approach helped to identify several additional applications, that make an important contribution to the total amount of solvents used. Thus in a third step the quantities of solvents used in these applications such as windscreens wiper fluids, antifreeze, hospitals, de-icing agents of aeroplanes, tourism, cement- respectively pulp industry, were estimated in surveys.

The outcome of these three steps was the total stock of solvents used for each application in the year 2000 (at SNAP level 3) (WINDSPERGER et al. 2002a).

To achieve a time series the development of the economic and technical situation in relation to the year 2000 was considered. It was distinguished between "general aspects" and "specific aspects" (see tables below). The information about these defined aspects were collected for three pillar years (1980, 1990, 1995) and were taken from several studies (SCHMIDT et al. 1998, BARNERT 1998) and expert judgements from associations of industries (chemical industry, printing industry, paper industry) and other stakeholders. On the basis of this information calculation factors were estimated. With these factors and the data for solvent use and emission of 2000 data for the three pillar years was estimated. For the years in between data was linearly interpolated. The 2000 data was also used for the subsequent years as no new survey has been conducted.

Table 127: General aspects and their development.

General aspects	1980	1990	1995	2000	2005
efficiency factor solvent cleaning	250%	150%	130%	100%	100%
efficiency factor application	150%	110%	105%	100%	100%
solvent content of water-based paints	15%	12%	10%	8%	8%
solvent content of solvent-based paints	60%	58%	55%	55%	55%
efficiency of waste gas purification	70%	75%	78%	80%	80%

Table 128: Specific aspects and their development: distribution of the used paints (water based-paints – solvent-based paints) and part of waste gas purification (application – purification).

SNAP category	description	year	Distribution of used paints		Part of waste gas treatment	
			Solvent based paints	Water based paints	application	purification
060101	manufacture of automobiles	2005	73%	27%	10%	0%
		2000				
		1995	80%	20%	8%	0%
		1990	90%	10%	5%	0%
		1980	100%	0%	0%	0%
060102	car repairing	2005	51%	49%	62%	1%
		2000				
		1995	55%	45%	60%	0%
		1990	75%	25%	10%	0%
		1980	85%	15%	5%	0%
060107	wood coating	2005	46%	54%	46%	3%
		2000				
		1995	60%	40%	45%	2%
		1990	85%	15%	10%	0%
		1980	100%	0%	0%	0%
060108	Other industrial paint application	2005	97%	3%	90%	46%
		2000				
		1995	99%	1%	87%	45%
		1990	100%	0%	26%	20%
		1980	100%	0%	0%	0%
060201	Metal degreasing	2005	92%	8%	75%	0%
		2000				
		1995	95%	5%	65%	0%
		1990	100%	0%	10%	0%
		1980	100%	0%	0%	0%

SNAP category	description	year	Distribution of used paints		Part of waste gas treatment	
			Solvent based paints	Water based paints	application	purification
060403	Printing industry	2005			44%	17%
		2000				
		1995			29%	10%
		1990			10%	5%
		1980			0%	0%
060405	Application of glues and adhesives	2005			58%	0%
		2000				
		1995			53%	0%
		1990			15%	0%
		1980			0%	0%
060103	Paint application: construction and buildings	2005	91%	9%	19%	4%
		2000				
		1995	93%	7%	15%	2%
		1990	100%	0%	5%	0%
		1980	100%	0%	0%	0%
060105	Paint application : coil coating	2005	100%	0%	63%	0%
		2000				
		1995	100%	0%	60%	0%
		1990	100%	0%	25%	0%
		1980	100%	0%	0%	0%
060406	Preservation of wood	2005	83%	17%	0%	0%
		2000				
		1995	85%	15%	0%	0%
		1990	95%	5%	0%	0%
		1980	100%	0%	0%	0%
060412	Other (preservation of seeds,…)	2005	100%	0%	90%	0%
		2000				
		1995	100%	0%	80%	0%
		1990	100%	0%	10%	0%
		1980	100%	0%	0%	0%

Table 129: Specific aspects and their development: changes in the number of employees compared to the year 2000.

SNAP		Changes in the number of employees compared to the year 2000				
		1980	1990	1995	2000	2005
0601	**Paint application**					
060101	manufacture of automobiles	88%	82%	72%	100%	131%
060102	car repairing	94%	98%	96%	100%	107%
060103	construction and buildings	96%	90%	102%	100%	106%
060104	domestic use	separate analysed				
060105	coil coating	99%	113%	107%	100%	96%
060107	wood coating	107%	109%	112%	100%	90%
060108	industrial paint application	122%	112%	106%	100%	101%
0602	**Degreasing, dry cleaning and electronics**					
060201	Metal degreasing	151%	113%	83%	100%	104%
060202	Dry cleaning	63%	75%	88%	100%	103%
060203	Electronic components manufacturing	143%	122%	104%	100%	84%
060204	Other industrial cleaning	33%	77%	56%	100%	130%
0603	**Chemical products manufacturing and processing**					
060305	Rubber processing	110%	101%	102%	100%	75%
060306	Pharmaceutical products manufacturing	118%	112%	97%	100%	90%
060307	Paints manufacturing	118%	112%	97%	100%	101%
060308	Inks manufacturing	118%	112%	97%	100%	100%
060309	Glues manufacturing	118%	112%	98%	100%	62%
060310	Asphalt blowing	124%	120%	120%	100%	94%
060311	Adhesive, magnetic tapes, films and photographs	33%	57%	76%	100%	97%
060312	Textile finishing	241%	171%	132%	100%	71%
060314	Other	117%	112%	98%	100%	88%
0604	**Other use of solvents and related activities**					
060403	Printing industry	129%	125%	111%	100%	85%
060404	Fat, edible and non edible oil extraction	129%	116%	112%	100%	52%
060405	Application of glues and adhesives	239%	156%	104%	100%	56%
060406	Preservation of wood	108%	105%	100%	100%	110%
060407	Under seal treatment and conservation of vehicles	97%	102%	103%	100%	101%
060408	Domestic solvent use (other than paint application	separate analysed				
060411	Domestic use of pharmaceutical products (k)					
060412	Other (preservation of seeds, …)	108%	105%	101%	100%	107%

A comprehensive summary on the methodology for the year 2000 can also be found in the Austrian Informative Inventory Report (UMWELTBUNDESAMT 2009).

5.2.4 Combination Top down – Bottom up approach and updating

To verify and adjust the data the solvents given in the top down approach and the results of the bottom up approach were differentiated in the pillar years (1980, 1990, 1995, 2000) by 15 defined categories of solvent groups. For the updated pillar year 2005 only the total difference is shown because no complete bottom up survey was carried out (see below Table 130). The differences between the quantities of solvents from the top down approach and bottom up approach between 1980 and 2000 respectively are lower than 15%. Since 2000 no new bottom up survey has been conducted, therefore the difference has been increased up to 25%. Table 130 shows the range of the differences in the considered pillar years broken down to the 15 substance categories.

Table 130:Differences between the results of the bottom up and the top down approach.

	Acetone	Methanol	Propanol	Solvent naphta	Paraffins	Alcohols	Glycols	Ester	Aromates	Ether	org. acids	Ketones	Aldehydes	Amines	cycl. Hydrocarb.	Others	Sum of Differences [kt/a]
2005																	-44
2000																	-24
1995																	-7
1990																	8
1980																	-26

difference less than 2 kt/a
difference 2–10 kt/a
difference greater than 10 kt/a

As the data of the top down approach were obtained from national statistics, they are assumed to be more reliable than the data of the bottom up approach. That's why the annual quantities of solvents used were taken from the top down approach while the share of the solvents for the different applications (on SNAP level 3) and the solvent emission factors have been calculated on the basis of the bottom up approach. Table 131 presents activity data and implied emission factors.

The inventory has been updated with data from (WINDSPERGER et al. 2008).

Table 131: Activity data for solvent and other product use [Mg].

IPCC				3.A				
SNAP	Total	060101	060102	060103	060104	060105	060107	060108
Unit					Mg Solvent			
1990	54 665	1 785	995	3 827	4 535	5 626	7 002	30 896
1991	48 827	1 515	889	3 542	3 558	5 061	6 139	28 124
1992	41 825	1 230	763	3 140	2 627	4 366	5 160	24 540
1993	45 119	1 254	823	3 502	2 382	4 742	5 460	26 956
1994	45 044	1 179	823	3 609	1 929	4 767	5 345	27 392
1995	52 085	1 280	953	4 304	1 714	5 550	6 059	32 226
1996	49 249	1 303	904	4 073	1 666	5 177	5 537	30 589
1997	52 612	1 495	968	4 355	1 830	5 452	5 702	32 809
1998	47 117	1 435	870	3 904	1 686	4 809	4 907	29.505
1999	42 917	1 399	796	3 559	1 581	4 311	4 281	26 991
2000	50 391	1 755	938	4 183	1 911	4 976	4 794	31 834
2001	53 759	1 977	1 008	4 486	2 035	5 232	4 980	34 042
2002	59 892	2 318	1 130	5 023	2 264	5 744	5 400	38 013
2003	61 757	2 507	1 174	5 206	2.331	5.837	5 417	39 286
2004	53 410	2 268	1 022	4 524	2 013	4 974	4 556	34 053
2005	57 101	2 530	1 100	4 860	2 148	5 240	4 736	36 486
2006	67 010	2 969	1 291	5 704	2 521	6 150	5 557	42 818
2007	61 407	2 721	1 183	5 227	2 310	5 636	5 093	39 238
2008	62 733	2 780	1 208	5 340	2 360	5 757	5 203	40 085

IPCC			3.B		
SNAP	Total	060201	060202	060203	060204
Unit			Mg Solvent		
1990	15 926	9 258	459	2 191	4 017
1991	14 001	7 866	408	1 902	3 826
1992	11 803	6 394	348	1 582	3 479
1993	12 527	6 528	373	1 655	3 971
1994	12 302	6 149	370	1 602	4 181
1995	13 990	6 687	426	1 794	5 083
1996	13 989	6 626	417	1 694	5 252
1997	15 792	7 415	461	1 808	6 107
1998	14 933	6 955	428	1 617	5 933
1999	14 353	6 634	404	1 471	5 844
2000	17 773	8 155	492	1 725	7 401
2001	19 308	8 696	524	1 768	8 321
2002	21 892	9 682	582	1 890	9 738
2003	22 962	9 978	600	1 867	10 517
2004	20 190	8 625	518	1 545	9 501
2005	21 934	9 216	553	1 579	10 586
2006	25 741	10 816	648	1 853	12 424
2007	23 588	9 911	594	1 698	11 385
2008	24 098	10 125	607	1 735	11 630

IPCC					3.C					
SNAP	Total	060305	060306	060307	060308	060309	060310	060311	060312	060314
Unit					Mg Solvent					
1990	18 585	977	8 272	3 170	359	829	1 329	3	157	3 488
1991	15 609	853	6 886	2 582	313	743	1 158	3	131	2 940
1992	12 525	714	5 470	1 998	262	639	967	3	105	2 369
1993	12 603	752	5 440	1 926	275	691	1 017	3	104	2 394
1994	11 679	733	4 973	1 695	268	692	989	3	96	2 230
1995	12 465	826	5 223	1 697	302	803	1 114	4	101	2 395
1996	12 305	749	5 614	1 525	282	791	987	4	89	2 265
1997	13 722	764	6 749	1 541	297	879	980	4	87	2 420
1998	12 828	650	6 746	1 298	263	819	809	4	71	2 167
1999	12 196	561	6 812	1 104	236	777	671	4	57	1 974
2000	14 948	619	8 816	1 200	273	949	708	5	59	2 319
2001	15 523	623	9 163	1 256	290	928	742	5	58	2 457
2002	16 827	653	9 944	1 372	321	942	812	6	60	2 718
2003	16 877	632	9 983	1 387	328	877	822	6	57	2 784
2004	14 191	511	8 404	1 176	282	678	698	5	45	2 392
2005	14 744	508	8 742	1 233	300	640	733	5	44	2 540
2006	17 303	597	10 258	1 446	352	751	860	6	51	2 981
2007	15 856	547	9 401	1 326	322	688	788	6	47	2 732
2008	16 198	558	9 604	1 354	329	703	805	6	48	2 790

IPCC					3.D.5				
SNAP	Total	060403	060404	060405	060406	060407	060408	060411	060412
Unit					Mg Solvent				
1990	48 748	14 729	510	836	677	217	13 842	4 984	12 952
1991	44 506	13 050	442	717	601	197	13 305	4 578	11 617
1992	38 946	11 089	366	588	512	171	12 200	4 029	9 992
1993	42 897	11 865	382	607	549	186	14 023	4 462	10 823
1994	43 705	11 749	369	579	545	188	14 857	4 569	10 849
1995	51 548	13 474	412	637	627	220	18 167	5 416	12 595
1996	49 960	12 541	369	601	594	203	18 238	5 265	12 149
1997	54 728	13 177	370	640	637	211	20 664	5 784	13 245
1998	50 278	11 594	309	571	572	183	19 608	5 329	12 110
1999	46 998	10 364	261	519	522	162	18 907	4 996	11 267
2000	56 657	11 929	281	607	615	184	23 483	6 040	13 519
2001	59 520	12 268	269	587	666	195	24 647	6 433	14 456
2002	65 295	13 164	265	587	752	216	27 013	7 155	16 142
2003	66 294	13 061	239	538	785	221	27 401	7 366	16 681
2004	56 452	10 858	178	408	688	190	23 311	6 361	14 459
2005	59 422	11 147	159	375	745	203	24 513	6 790	15 491
2006	69 734	13 082	187	440	874	238	28 767	7 968	18 179
2007	63 903	11 988	171	403	801	218	26 362	7 302	16 659
2008	65 283	12 247	175	412	818	223	26 931	7 459	17 019

5.2.5 Calculation of CO_2 emissions from Solvent Emissions

The basis for the calculation of the carbon dioxide emissions were the quantities of solvent emissions differentiated by the 15 groups of substances (acetone, methanol, propanol, solvent naphtha, paraffins, alcohols, glycols, ester, aromates, ketones, aldehydes, amines, organic acids, cyclic hydrocarbons, and others). Substance specific carbon dioxide factors for these 15 substance groups have been created (see Table 132) on the basis of the carbon content and the stoichiometrically formed CO_2.

Table 132: Substance specific carbon dioxide emission factors.

Substances	CO_2 factor [kg CO_2/kg substance]	Substances	CO_2 factor [kg CO_2/kg substance]
Acetone	2.28	Glycols	1.82
Aldehydes	2.44	Ketones	2.45
Alcohols	1.91	Methanol	1.38
Alcohols/Propanols	2.20	Paraffins	3.14
Aromates	3.33	Residuals	0.92
Cydic Hydrocarbons	3.14	Solvent naphta	3.14
Ester	2.16	Glycols	1.82

The amount of carbon dioxide emissions was disaggregated to SNAP level 3 according to the share of solvents used and solvent emissions that were calculated in the context of the bottom up approach. In Table 133 the carbon dioxide emissions of Category 3 Solvent and Other Product Use for the years 1990 to 2008 are shown.

Table 133: CO_2 emission of Category 3 Solvent and Other Product Use 1990–2008.

IPCC		3.A						
SNAP	Total	060101	060102	060103	060104	060105	060107	060108
Unit		Mg Solvent						
1990	117.70	4.67	2.56	9.98	10.68	13.43	17.50	58.90
1991	95.63	3.67	2.30	9.15	8.15	11.19	14.50	46.68
1992	73.70	2.73	1.95	7.91	5.85	8.85	11.40	35.00
1993	71.30	2.53	2.07	8.54	5.23	8.80	11.27	32.85
1994	63.13	2.15	2.01	8.40	4.22	8.02	10.21	28.12
1995	67.29	2.18	2.35	9.92	4.03	8.81	11.15	28.85
1996	59.65	2.07	2.11	9.09	3.77	7.74	9.65	25.23
1997	63.96	2.38	2.29	10.07	4.26	8.23	10.07	26.66
1998	56.38	2.25	2.05	9.19	3.95	7.18	8.63	23.13
1999	50.33	2.15	1.85	8.49	3.72	6.34	7.47	20.30
2000	58.52	2.68	2.19	10.24	4.56	7.29	8.39	23.17
2001	62.37	3.02	2.35	10.98	4.86	7.67	8.72	24.77
2002	69.41	3.54	2.64	12.29	5.41	8.42	9.45	27.66
2003	71.50	3.83	2.74	12.74	5.57	8.56	9.48	28.59
2004	61.78	3.46	2.39	11.07	4.81	7.29	7.98	24.78
2005	65.98	3.86	2.57	11.89	5.13	7.68	8.29	26.55

IPCC	3.A							
SNAP	Total	060101	060102	060103	060104	060105	060107	060108
Unit	Mg Solvent							
2006	77.43	4.53	3.01	13.96	6.02	9.01	9.73	31.16
2007	70.96	4.16	2.76	12.79	5.52	8.26	8.92	28.56
2008	72.49	4.25	2.82	13.07	5.64	8.44	9.11	29.17

IPCC	3.B				
SNAP	Total	060201	060202	060203	060204
Unit	Mg Solvent				
1990	35.51	22.89	0.50	4.25	7.86
1991	29.10	17.72	0.48	3.33	7.56
1992	22.63	12.94	0.43	2.47	6.79
1993	22.11	11.78	0.48	2.28	7.57
1994	19.79	9.73	0.49	1.92	7.65
1995	21.33	9.57	0.59	1.93	9.24
1996	20.12	8.70	0.56	1.70	9.16
1997	22.94	9.57	0.64	1.81	10.91
1998	21.49	8.66	0.61	1.59	10.64
1999	20.38	7.94	0.58	1.41	10.45
2000	25.17	9.49	0.72	1.62	13.34
2001	27.55	10.12	0.77	1.66	14.99
2002	31.45	11.27	0.86	1.78	17.55
2003	33.20	11.61	0.88	1.76	18.95
2004	29.38	10.04	0.76	1.45	17.12
2005	32.10	10.73	0.81	1.48	19.07
2006	37.67	12.59	0.96	1.74	22.38
2007	34.52	11.54	0.88	1.60	20.51
2008	35.27	11.79	0.90	1.63	20.96

IPCC	3.C									
SNAP	Total	060305	060306	060307	060308	060309	060310	060311	060312	060314
Unit	Mg Solvent									
1990	27.94	2.82	8.21	8.80	0.64	2.22	0.04	0.01	0.33	4.87
1991	21.55	2.46	6.20	6.36	0.50	1.82	0.04	0.01	0.28	3.88
1992	15.48	2.04	4.39	4.17	0.36	1.35	0.03	0.01	0.22	2.92
1993	15.27	2.11	3.85	4.31	0.41	1.57	0.03	0.01	0.22	2.76
1994	13.37	2.01	3.03	3.78	0.39	1.55	0.03	0.01	0.20	2.37
1995	15.08	2.30	2.80	4.61	0.53	2.13	0.04	0.01	0.22	2.45
1996	13.48	1.99	2.92	3.80	0.46	1.93	0.03	0.01	0.18	2.16
1997	15.41	2.07	3.62	4.27	0.53	2.39	0.03	0.01	0.18	2.30
1998	13.38	1.77	3.65	3.28	0.43	2.05	0.03	0.01	0.15	2.02

IPCC	3.C									
SNAP	Total	060305	060306	060307	060308	060309	060310	060311	060312	060314
Unit	Mg Solvent									
1999	11.91	1.53	3.69	2.59	0.36	1.80	0.02	0.01	0.12	1.79
2000	15.03	1.71	4.82	3.23	0.49	2.55	0.02	0.01	0.13	2.07
2001	15.47	1.72	5.01	3.38	0.51	2.49	0.02	0.01	0.13	2.19
2002	16.63	1.81	5.43	3.69	0.57	2.53	0.03	0.01	0.13	2.43
2003	16.52	1.75	5.45	3.74	0.58	2.35	0.03	0.01	0.12	2.48
2004	13.76	1.41	4.59	3.17	0.50	1.82	0.02	0.01	0.10	2.13
2005	14.15	1.41	4.78	3.32	0.53	1.72	0.02	0.01	0.10	2.27
2006	16.60	1.65	5.60	3.89	0.62	2.02	0.03	0.01	0.11	2.66
2007	15.22	1.51	5.14	3.57	0.57	1.85	0.03	0.01	0.10	2.44
2008	15.54	1.55	5.25	3.65	0.58	1.89	0.03	0.01	0.11	2.49

IPCC	3.D.5								
SNAP	Total	060403	060404	060405	060406	060407	060408	060411	060412
Unit	Mg Solvent								
1990	98.15	29.19	0.34	2.13	1.83	0.41	25.93	10.71	27.62
1991	87.21	24.56	0.29	1.74	1.63	0.38	25.57	10.03	23.00
1992	73.34	19.62	0.24	1.35	1.38	0.33	23.41	8.82	18.19
1993	77.30	19.70	0.25	1.31	1.46	0.37	26.47	9.67	18.07
1994	74.47	18.13	0.24	1.17	1.41	0.36	27.07	9.64	16.45
1995	86.26	20.11	0.27	1.25	1.64	0.43	33.00	11.50	18.05
1996	79.91	17.69	0.23	1.12	1.49	0.38	31.80	10.74	16.47
1997	89.57	18.81	0.24	1.20	1.64	0.41	36.96	12.13	18.18
1998	82.58	16.44	0.20	1.06	1.49	0.36	35.26	11.27	16.51
1999	77.13	14.54	0.17	0.95	1.36	0.32	34.00	10.60	15.19
2000	93.90	16.74	0.19	1.11	1.63	0.37	42.64	12.99	18.23
2001	98.71	17.21	0.18	1.08	1.77	0.40	44.75	13.83	19.49
2002	108.36	18.47	0.18	1.08	1.99	0.44	49.05	15.39	21.77
2003	110.09	18.32	0.16	0.99	2.08	0.45	49.75	15.84	22.49
2004	93.81	15.23	0.12	0.75	1.83	0.39	42.32	13.68	19.50
2005	98.82	15.64	0.11	0.69	1.98	0.41	44.51	14.60	20.89
2006	115.96	18.35	0.12	0.81	2.32	0.48	52.23	17.13	24.51
2007	106.27	16.82	0.11	0.74	2.13	0.44	47.86	15.70	22.46
2008	108.56	17.18	0.12	0.76	2.17	0.45	48.90	16.04	22.95

Table 134: Implied CO_2 Emission factors for Category 3 Solvent and Other Product Use 1990–2008.

IPCC	3.A						
SNAP	**060101**	**060102**	**060103**	**060104**	**060105**	**060107**	**060108**
Unit	**[tCO_2/t]**						
1990	2.61	2.57	2.61	2.36	2.39	2.50	1.91
1991	2.42	2.58	2.58	2.29	2.21	2.36	1.66
1992	2.22	2.56	2.52	2.23	2.03	2.21	1.43
1993	2.02	2.52	2.44	2.19	1.86	2.06	1.22
1994	1.82	2.45	2.33	2.19	1.68	1.91	1.03
1995	1.70	2.47	2.30	2.35	1.59	1.84	0.90
1996	1.59	2.33	2.23	2.26	1.50	1.74	0.82
1997	1.60	2.37	2.31	2.32	1.51	1.77	0.81
1998	1.57	2.35	2.35	2.34	1.49	1.76	0.78
1999	1.54	2.33	2.39	2.35	1.47	1.74	0.75
2000	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2001	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2002	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2003	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2004	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2005	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2006	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2007	1.53	2.34	2.45	2.39	1.47	1.75	0.73
2008	1.53	2.34	2.45	2.39	1.47	1.75	0.73

IPCC	3.B			
SNAP	**060201**	**060202**	**060203**	**060204**
Unit	**[tCO_2/t]**			
1990	2.47	1.10	1.94	1.96
1991	2.25	1.18	1.75	1.98
1992	2.02	1.25	1.56	1.95
1993	1.80	1.29	1.38	1.91
1994	1.58	1.31	1.20	1.83
1995	1.43	1.38	1.08	1.82
1996	1.31	1.34	1.01	1.74
1997	1.29	1.39	1.00	1.79
1998	1.24	1.42	0.98	1.79
1999	1.20	1.44	0.96	1.79
2000	1.16	1.47	0.94	1.80
2001	1.16	1.47	0.94	1.80
2002	1.16	1.47	0.94	1.80
2003	1.16	1.47	0.94	1.80
2004	1.16	1.47	0.94	1.80

2005	1.16	1.47	0.94	1.80
2006	1.16	1.47	0.94	1.80
2007	1.16	1.47	0.94	1.80
2008	1.16	1.47	0.94	1.80

IPCC	**3.C**								
SNAP	**060305**	**060306**	**060307**	**060308**	**060309**	**060310**	**060311**	**060312**	**060314**
Unit	**[tCO_2/t]**								
1990	2.88	0.99	2.77	1.78	2.68	0.03	2.18	2.11	1.40
1991	2.88	0.90	2.46	1.61	2.45	0.03	2.23	2.11	1.32
1992	2.85	0.80	2.09	1.38	2.11	0.03	2.22	2.09	1.23
1993	2.81	0.71	2.24	1.49	2.27	0.03	2.19	2.07	1.15
1994	2.75	0.61	2.23	1.47	2.24	0.03	2.12	2.05	1.06
1995	2.79	0.54	2.71	1.76	2.65	0.03	2.13	2.14	1.02
1996	2.66	0.52	2.49	1.62	2.45	0.03	2.05	2.04	0.95
1997	2.71	0.54	2.77	1.80	2.72	0.03	2.12	2.09	0.95
1998	2.72	0.54	2.53	1.65	2.50	0.03	2.14	2.11	0.93
1999	2.73	0.54	2.34	1.53	2.32	0.03	2.15	2.13	0.91
2000	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2001	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2002	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2003	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2004	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2005	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2006	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2007	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89
2008	2.77	0.55	2.69	1.78	2.68	0.03	2.18	2.19	0.89

IPCC	**3.D.5**							
SNAP	**060403**	**060404**	**060405**	**060406**	**060407**	**060408**	**060411**	**060412**
Unit	**[tCO_2/t]**							
1990	1.98	0.66	2.55	2.70	1.89	1.87	2.15	2.13
1991	1.88	0.67	2.42	2.72	1.95	1.92	2.19	1.98
1992	1.77	0.66	2.29	2.69	1.96	1.92	2.19	1.82
1993	1.66	0.65	2.16	2.66	1.96	1.89	2.17	1.67
1994	1.54	0.64	2.02	2.59	1.93	1.82	2.11	1.52
1995	1.49	0.66	1.97	2.61	1.96	1.82	2.12	1.43
1996	1.41	0.63	1.86	2.51	1.88	1.74	2.04	1.36
1997	1.43	0.64	1.88	2.58	1.94	1.79	2.10	1.37
1998	1.42	0.65	1.86	2.60	1.96	1.80	2.11	1.36
1999	1.40	0.65	1.84	2.61	1.98	1.80	2.12	1.35

IPCC	3.D.5							
SNAP	060403	060404	060405	060406	060407	060408	060411	060412
Unit	[tCO_2/t]							
2000	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2001	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2002	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2003	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2004	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2005	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2006	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2007	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35
2008	1.40	0.66	1.84	2.65	2.03	1.82	2.15	1.35

5.2.6 QA/QC

The calculations of the data for category 5 are embedded in the overall QA/QC-system of the Austrian GHG inventory (see Chapter 1.6).

Important elements of QA/QC:

✓ Are the correct values used (check for transcription errors, …)?

✓ Check of plausibility of input data (time-series, order of magnitude, …)

✓ Is the data set complete for the whole time series?

✓ Check of calculations, units ...

✓ Check of plausibility of results (time-series, order of magnitude, …)

✓ Correct transformation/transcription into CRF

✓ Where possible, data is checked with data from other sources, order of magnitude checks, …

✓ Are all references clearly made?

✓ Are all assumptions documented?

Specific elements of QA/QC for Solvent and Other Product Use

The input data, estimates and results are checked as follows. The results of these checks are described in the QA/QC documentation:

Bottom-up check

Input data and emission factors

- Check for the plausibility of the activity data and their trend and check for plausibility of the emission factors as well as the related input data and their trends

  ✓ Documentation of the most important reasons for changes and non-changes of activity data

  ✓ Check and documentation, if these changes or non-changes of activity data fit to trends of underlying conditions

✓ If checks do not allow any explanation, further check of the used statistics and their estimates and/or communication with the data providers

- Check of input data for completeness

Emissions

- Check of the correctness of all equations in the estimate files
- Check of the correctness of all interim results
- Check of the plausibility of the results and their trends related to activity data and emission factors and documentation of the plausibility of changes and non-changes as above mentioned
- Check of the correctness of all data and results transfer

Top-down check

- Comparison of the used activity data with those from other statistics: Statistik Austria publication and EUROSTAT database. Documentation of the results of these comparisons and documentation of the reasons for the choice of statistics when data deviate more than 5 % compared to other statistics
- Comparison of the used activity data with those from relevant plant operators and associations. Documentation of the results of these comparisons and documentation of the reasons for the choice of statistics when data deviate more than 5 % compared to other statistics
- Comparison of the used emission factors and underlying input data with those of other data sources (e.g. from literature, association publications, results in NIRs of other comparable regions, IPCC default values). Documentation of the results of these comparisons. Further checks according to the points mentioned above as well as check on the suitability of the used input data in case of implausible differences. Documentation of this further check.

5.2.7 Uncertainty Assessment

In the latest study on uncertainties of the Austrian inventory (WINIWARTER 2008) (see Chapter 1.7) the uncertainties of solvent emissions in Austria were determined, and were compared with the results of the detailed analysis of solvent emissions in Austria (WINDSPERGER et al. 2004) (see also NIR 2006). Differences between bottom-up and top-down methodology to estimate emissions were calculated at less than 10%, which is compatible with expert estimates on the uncertainties presented for national statistics. Additional uncertainty has been attributed to the released fraction of solvents employed, reflecting an emission factor (solvents are released as volatile organic compounds, which eventually are converted into CO_2 in the atmosphere).

Using the WINDSPERGER et al. (2004) data, an uncertainty of 5% is attributed to the activity data, and 10% to the emission factor of solvents. According to WINDSPERGER et al. (2004), the uncertainty should decrease and the overall quality improve between 1990 and current data. But according to WINIWARTER (2008) a general decrease in the quality of the import-export statistics, and a decrease in the released fraction of solvents (reflecting the emission factor) over the years results in a constant uncertainty.

In Table 135 and Table 136 the results of the studies are presented whereas the results of WINIWARTER (2008) are used for calculating the total uncertainty of the Austrian GHG inventory.

Table 135: Uncertainties of Sector 3 Solvent and other product use (WINDSPERGER et al. 2004).

	1990	1995	2000
Uncertainty solvent emissions	-21 to +24%	-18 to +21%	-13 to +14%

Table 136: Uncertainties of Sector 3 Solvent and other product use (WINIWARTER 2008).

IPCC Source category	Gas	AD	EF	Combined
			Uncertainty [%]	
3: Solvent and other product use	CO_2	5.0	10.0	11.2

5.3 N_2O Emissions from Solvent and Other Product Use (IPCC Sector 3.D.1, 3.D.2 and 3.D.3)

	3.D.1 Use of N_2O for anaesthesia	3.D.3 Use of N_2O in aerosol cans	3.D.2 Use of N_2O in fire extinguishers
GHG key category	no	no	not ocurring
gas	N_2O emission from the use of anaesthesia	N_2O emission from the use of aerosol cans	–
activity	N_2O consumption of anaesthesia	N_2O consumption in aerosol cans	N_2O is not flammable, but has oxidising properties. There is no evidence of this gas being used in fire extinguishers in Austria.
	Due to new industry inquiries (ÖIGV 2008) the amount of N_2O used for anaesthesia was updated for the years 2001–2008.	It is assumed that the use of N_2O for aerosol cans is constant at 400 tons per year. This estimate is based on expert judgement and industry inquiries (ÖIGV 2008).	
method	A specific methodology for these activities has not been prepared yet.[55]		–
	100% of N_2O used for anaesthesia is released into atmosphere	100% of N_2O used for aerosol cans is released into atmosphere	
emission factor	activity data = emission 1.00 Mg N_2O/Mg product use		–

[55] EMEP/EEA air pollutant emission inventory guidebook — 2009. Technical report No 6/2009. Prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections (TFEIP) and published by the European Environment Agency (EEA).

Table 137: N_2O-consumption of anaesthesia and N_2O-consumption in aerosol cans.

	3 D	3.D.1	3.D.3
	Total (use of N_2O)	**use of N_2O for anaesthesia**	**use of N_2O in aerosol cans**
Unit		**Gg**	
1990	0.750	0.350	0.400
1991	0.750	0.350	0.400
1992	0.750	0.350	0.400
1993	0.750	0.350	0.400
1994	0.750	0.350	0.400
1995	0.750	0.350	0.400
1996	0.750	0.350	0.400
1997	0.750	0.350	0.400
1998	0.750	0.350	0.400
1999	0.750	0.350	0.400
2000	0.750	0.350	0.400
2001	0.712	0.312	0.400
2002	0.674	0.274	0.400
2003	0.636	0.236	0.400
2004	0.598	0.198	0.400
2005	0.560	0.160	0.400
2006	0.530	0.130	0.400
2007	0.517	0.117	0.400
2008	0.505	0.105	0.400

5.3.1 Uncertainty Assessment for N_2O Emissions from Solvent and Other Product Use

Direct use of N_2O has been specifically collected from industry experts in Austria. According to (WINIWARTER 2008) pursuant to (RAMIREZ et al. 2006) an uncertainty of 20% for the amount of N_2O is used. In contrast to Ramirez, it is assumed that virtually all of the N_2O actually used is also fully released thus no additional uncertainty is applied.

Table 138: Uncertainties of Sector 3.D Solvent and other product use.

IPCC Source category	Gas	AD	EF	Combined
			Uncertainty [%]	
3: Solvent and other product use	N_2O	20.0	0	20.0

5.4 Recalculation for emissions from solvent and other product use

To improve and update the solvent model a study (WINDSPERGER, 2008 (unpublished) was made. The results of which will be presented in the Informative Inventory Report (IIR) 2010.

Update of activity data

3.A, 3.B, 3.C and 3.D.5.:

The short term statistics for trade and services and the Austrian foreign trade statistics were updated from 2004 onwards.

The activity data from 2000 onwards concerning non-solvent use and solvent content of products has been updated by surveys at companies and associations.

Improvements of methodologies and emission factors

3.A, 3.B, 3.C and 3.D.5.:

Emission factors have been updated with information from surveys at companies and associations from 2004 onwards.

The table below shows the recalculation difference of CO_2 emissions from solvent and other product use and its subcategories with respect to the previous submission (the complete time series is presented in Annex 5). There were no recalculations for N_2O emissions.

Table 139: Recalculation difference with respect to submission 2009.

CO_2 Emission		**Absolute difference [Gg]**				**Relative difference [Δ%]**	
		1990	**2000**	**2006**	**2007**	**1990**	**2006**
3	Solvent and Other Product Use	0.00	0.06	-0.19	-21.57	=	-9%
3 A	Paint application	0.00	0.02	-0.06	-6.74	=	-9%
3 B	Degreasing and dry cleaning	0.00	0.01	-0.03	-3.28	=	-9%
3 C	Chemical products, manufacture and processing	0.00	0.00	-0.01	-1.45	=	-9%
3 D 5	Other solvent use	0.00	0.03	-0.09	-10.10	=	-9%