ARCADIS
Infrastructure, environment, facilities

Imagine the result

NMVOC emissions through domestic solvent use and the use of paints in the Brussels Capital Region

MAIN REPORT

Brussels Instituut voor Milieubeheer (BIM/IBGE)

Project number – 11-005441 | Version E | 02-11-2010

CLIENT	**BIM** **Gulledelle 100** **1200 Brussel** **Laurent Bodarwé** **+32 2 775 79 67.** **lbo@ibgebim.be**

PROJECT DESCRIPTION
This report contains the development of a methodology to estimate the NMVOC emissions in the BCR through the use of paints by consumers and professional users and the use of other solvents in households. Based on that methodology, emissions are calculated for the current situation, the period 1990-2007 and also includes a future scenario.

STUDY	**ARCADIS Belgium nv** **Kortrijksesteenweg 302** **9000 Gent** **VAT BE 0426.682.709** **RPR ANTWERPEN** **ING 320-0687053-72** **IBAN BE 38 3200 6870 5372** **BIC BBRUBEBB**
Contact	**Annick Van Hyfte**
Telephone	**+32 9 241 77 28**
Telefax	**+32 9 242 44 45**
E-mail	**a.vanhyfte@arcadisbelgium.be**
Website	**www.arcadisbelgium.be**

Table of contents

Table of contents **3**
Figures **5**
Tables **7**
Annexes **9**
BACKGROUND AND AIM **11**
DESCRIPTION OF THE GENERAL WORK PLAN **13**
PART 1 OVERVIEW OF AVAILABLE INFORMATION **15**
1 METHODS USED IN DIFFERENT REGIONS/COUNTRIES **15**
1.1 GENERAL GUIDELINES FROM EMEP / Corinair 15
1.1.1 Description of methodology 15
1.1.2 Discussion 19
1.2 Current methodology used by BIM 20
1.3 Description of methods used in other regions/countries 22
1.3.1 Flemish region 22
1.3.2 Walloon region 23
1.3.3 The Netherlands 23
1.3.4 France 24
1.3.5 Sweden 25
1.3.6 Germany 25
1.3.7 Norway 26
1.3.8 Denmark 29
1.3.9 Finland and Iceland 30
2 INTERNATIONAL REPORTING OBLIGATIONS **31**
2.1 Description 31
2.1.1 UNECE EMEP/LRTAP 31
2.1.2 UNFCCC 32
2.1.3 RAINS/GAINS 33
2.2 Linking of codes 33
3 RELEVANT LEGISLATION **35**
3.1 Cosmetics Directive 76/768/EC 35
3.2 VOC Solvents emissions Directive 1999/13/EC 35
3.3 VOC paints directive 2004/42/EC 36
3.4 Monitoring reports 37
3.5 Assessment and review of Directive 2004/42/EC: project coordinated by Ökopol GmbH 39
4 AVAILABILITY OF RELEVANT DATA FOR BCR **43**
4.1 Paint 43
4.1.1 Sales data from IVP 43
4.1.2 Data on NMVOC content of paints by CEPE 43

4.2 Other household products 45
4.2.1 Sales data and NMVOC contents from DETIC 45
4.2.2 Consumption data through GfK Panel Services Belgium 45
4.2.3 Consumption data from the household budget survey 46
4.2.4 Other explored links and publications 48
PART 2 SETTING UP AN EMISSION INVENTORY FOR THE BRUSSEL CAPITAL REGION 53
5 ASSESSMENT OF DESCRIBED METHODS AND DATA 53
5.1 General assessment 53
5.2 Selection of most important households products 56
5.2.1 Products used in households with NMVOC-emissions 56
5.2.2 Information availability on the identified products 56
5.2.3 Selection of the products with the largest emissions 56
6 DEVELOPMENT METHOD FOR BCR 1990-2008 58
6.1 Use of paint 58
6.1.1 Sales data (A_{DP}) and fraction solvent/water based (F_S, F_W) 58
6.1.2 Solvent content (SC_S, SC_W) 58
6.1.3 Fraction of decorative paint used by consumers or professionals ($F_{CON,PROF}$) 59
6.1.4 Allocation parameter from Belgium to the BCR ($ALL_{BCR, CON/PROF}$) 60
6.2 Household products 62
6.2.1 Consumption data for different solvent containing products (A_{SH}) 62
6.2.2 Solvent content for different solvent containing products (SC_{SH}) 67
6.2.3 Share of the solvent emitted to air (EF_{SH}) 68
6.2.4 Allocation parameter from Belgium consumption data to BCR (ALL_{SH}) 68
6.2.5 Calculation of appropriate EF based on emissions per inhabitant 70
6.2.6 Emission Factor per inhabitant for the use of household product [EF_{SH}] 70
6.2.7 1990-2008 71
7 RESULTS 1990-2007/2008 73
7.1 Domestic and architectural use of paints (NFR code 3A1) 73
7.2 Domestic solvent use (NFR code 3D2) 74
7.2.1 Comparison with the current method used by BIM 76
7.2.2 Cross-checks with alternative sources 79
8 FUTURE SCENARIO 81
8.1 Paint 81
8.1.1 Description of likely evolutions 81
8.1.2 2020 projections 82
8.2 Household products 83
8.2.1 Description of likely evolutions 83
8.2.2 2020 projections 84
9 LIMITS, SUGGESTIONS, RECOMMENDATIONS 85
REFERENCES 87

Figures

Figure 1: Evolution of VOC emissions during 1990-2008 in the Brussels Capital Region 11
Figure 2: Allocation of Total VOC emissions to different sources 11
Figure 3: NMVOC Emissions from most important product types within each sector in NFR extention 3Diii, 2007 in Norway (in tonnes) (Ref: Holmengen and Kittilsen, 2009) 28
Figure 4: NMVOC Emissions in NFR extensions 3Ai-iii by (industrial) sector in 2007 in Norway (in tonnes) (Ref: Holmengen and Kittilsen, 2009) 28
Figure 5: Trend in shares in total sales and solvent contents of waterbased paints in Belgium (CEPE, personal communication) 44
Figure 6: Trend in shares in total sales and solvent contents of solvent based paints in Belgium (CEPE, personal communication) 44
Figure 7: Overview of data on the solvent content of paint sold in Belgium (CEPE, 2010) 59
Figure 8: Trend of the emission factors for use of solvent containing products in The Netherlands (in g NMVOC per inhabitant) 72
Figure 9: Total NMVOC-emissions from domestic and architectural use of paint in the Brussels Capital Region in the period 1990-2007 73
Figure 10: NMVOC-emission from the use of household products (no paints) in the Brussels Capital Region (1990-2008) – by product group 76
Figure 11: Evolution of the sales data of WB and SB paint in Belgium for the period 1997-2007 (source: IVP) 81

Tables

Table 1: Abatement techniques (efficiency) to correct emission factors proposed in the EMEP / EEA 2009 guidebook 18

Table 2: Emission factors from various regions used in EMEP / EEA guidebook 2009 19

Table 3: Proposition of VOC emission levels for the domestic use of VOC containing products in Belgium (ECONOTEC/VITO, 2000)..... 21

Table 4: Emission factors used in the French emission inventory (CITEPA, 2009)..... 25

Table 5: Limit values in Directive 2004/42/EC..... 37

Table 6: non-compliant products VOC-content 38

Table 7: Options for review of 2004/42/EC..... 39

Table 8: Overview of sales data (85% market share) for decorative paints in Belgium in 2007 (IVP, 2010).. 43

Table 9: Overview of shares of paints of different segments in total sales data for decorative paints in Belgium (CEPE) (CEPE, personal communication, 2010) 44

Table 10: Overview of NMVOC-contents of paints of different segments in total sales data for decorative paints in Belgium (CEPE) (CEPE, personal communication, 2010) 44

Table 11: Weighted averaged NMVOC-contents (in g NMVOC per liter paint) of Water- and Solventbased paints used in Belgium (ARCADIS calculation based on CEPE information) 45

Table 12: Overview of sales data and VOC contents for different paint categories in Belgium for 2003 and 2006 (CEPE, 2008)..... 45

Table 13: Excerpt from the Household Budget Survey in 2007 in Belgium (House maintenance)..... 47

Table 14: VOC use and emission (kton/year) from cosmetics based on market survey data made available by NCV (IVAM, 2005) 49

Table 15: VOC use and emission (kton/year) from cleaning products, (partly) based on monitoring data from 2003 and 2004 made available by the NVZ (IVAM, 2005) 51

Table 16: Overview of the data needs to estimate NMVOC emissions through domestic solvent use 54

Table 17: Overview of the data needs to estimate NMVOC emissions through use of decorative paint in households 55

Table 18: Products with the largest NMVOC-emissions (calculations by Arcadis based on various sources for the Netherlands) 57

Table 19: Overview of the assumed solvent contents in paint for the proposed method**Fout! Bladwijzer niet gedefinieerd.**

Table 20: Overview of the assumed values for the Fraction of total decorative paints, used by consumers (F_{CON}) 60

Table 21: Allocation parameter for the BCR calculated based on the number of inhabitants..... 60

Table 22: Excerpt from the Household Budget Survey in 2007 in Belgium (Paint for internal and external applications)..... 60

Table 23: Calculation of the share of expenses for domestic use of paint in the BCR in total expenses in Belgium for 2007..... 61

Table 24: Overview of the assumed values for allocation parameter from Belgium to The Brussels Capital Region ($ALL_{BCR,CON}$)..... 61

Table 25: Overview of the number, average size and total volume (m³) of residential and non-residential buildings in Belgium and The Brussels Capital Region ($ALL_{BCR,PROF}$) in 2007 61
Table 26: Market share (units – EU27) different deodorants and antiperspirants 64
Table 27: Overview of the used VOC-contents and share emitted to ambient air for individual products 69
Table 28: Calculated emission factors for VOC emissions from the use of household products in the BCR (in kg per inhabitant per year) 70
Table 29: Trend of the emission factors for use of solvent containing products in The Netherlands (in kg NMVOC per inhabitant) 71
Table 30: Estimated emission factors for VOC emissions from the use of Household products in the BCR in the period 1990-2008 (in kg per inhabitant per year) 72
Table 31: Total NMVOC-emissions from domestic and architectural use of paint in the Brussels Capital Region in the period 1990-2007 (in tons NMVOC) 73
Table 32: NMVOC-emission from the use of household products (no paints) in the Brussels Capital Region (2008) 75
Table 33: NMVOC-emission from the use of household products (no paints) in the Brussels Capital Region (1990-2008) – by product group (in tons NMVOC) 76
Table 34: Comparison of EF for NMVOC-containing household products, as suggested in 1994 in The Netherlands and EF calculated from the current emission inventory for 1990, 1995 and 2008 (in kg NMVOC per inhabitant) 78
Table 35: Comparison of proposed emission factors (kg / inhabitant) with values from the Netherlands 80
Table 36: Values used to estimate NMVOC-emissions from the use of decorative paint in BCR (2020) 82
Table 37: Estimated NMVOC-emissions (in tons/year) from the use of decorative paint in BCR (2020) 83
Table 38: Projected NMVOC-emissions for BCR (2020) 84

Annexes

Confidential Annex

“NMVOC_emissions_in_BCR_Confidential Annex.docx”

Calculation model provided as an Excel©-application:

“NMVOC emissions in BCR_Calculation model.xlsx”

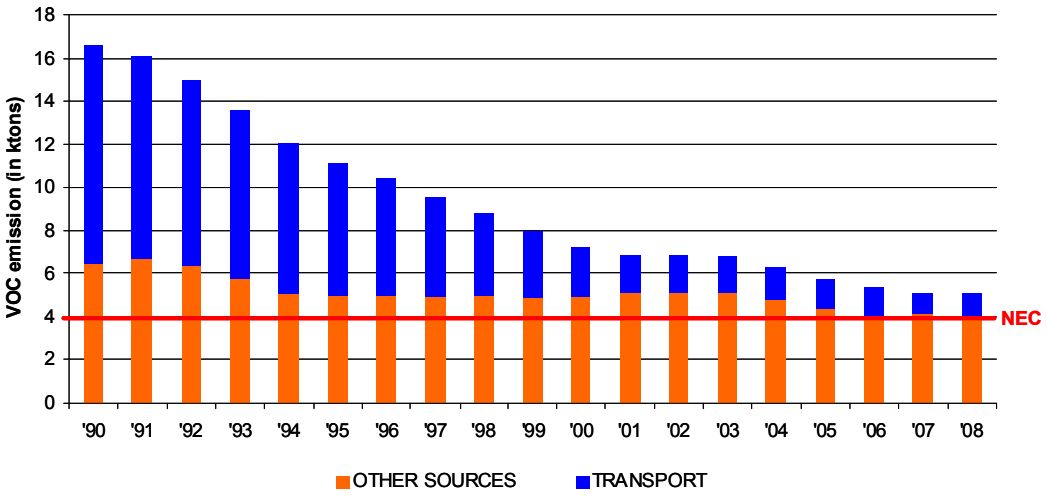
Background calculation of emission factors for household products provided as an Excel©-application:

“NMVOC emissions in BCR_Calculation of EF for household products.xlsx”

BACKGROUND AND AIM

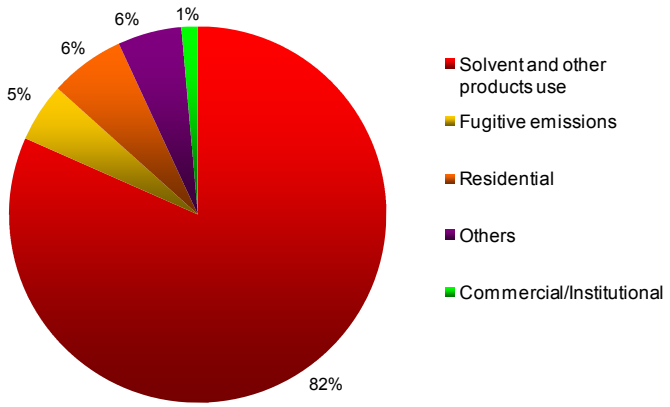
Figure 1 gives an overview of the total VOC emissions in the Brussels Capital Region as currently reported in the emission inventory. This figure makes a distinction between emission from transport and other sources. Total VOC emissions decreased by about 70% between 1990 and 2008. This important decrease is however particularly due to the substantial decrease by 91% in emissions from transport. The emissions from other sources reduced in the same period by about 36%.

Figure 1: Evolution of VOC emissions during 1990-2008 in the Brussels Capital Region



In 2008, emissions from other sources end up just above the threshold value of 4 ktons VOC as assigned to The Brussels Capital Region in the NEC Directive[1] (NEC Reduction Programme, 2006). Figure 2 gives an overview of the allocation of non-transport emissions to different sources. 83% of the emissions from "other sources" are attributed to "solvents and other product use".

Figure 2: Allocation of Total VOC emissions to different sources



[1]This Directive, known as the National Emission Ceilings Directive (NEC Directive), imposes absolute NOx, SO2, VOC and NH3 emission ceilings on the Member States of the European Union which have to be complied with from 2010 on. The emission ceiling for Belgium for VOC is set at 139 ktons of which 35.6 ktons for stationary sources. The other 103.4 ktons are attributed to the different regions.

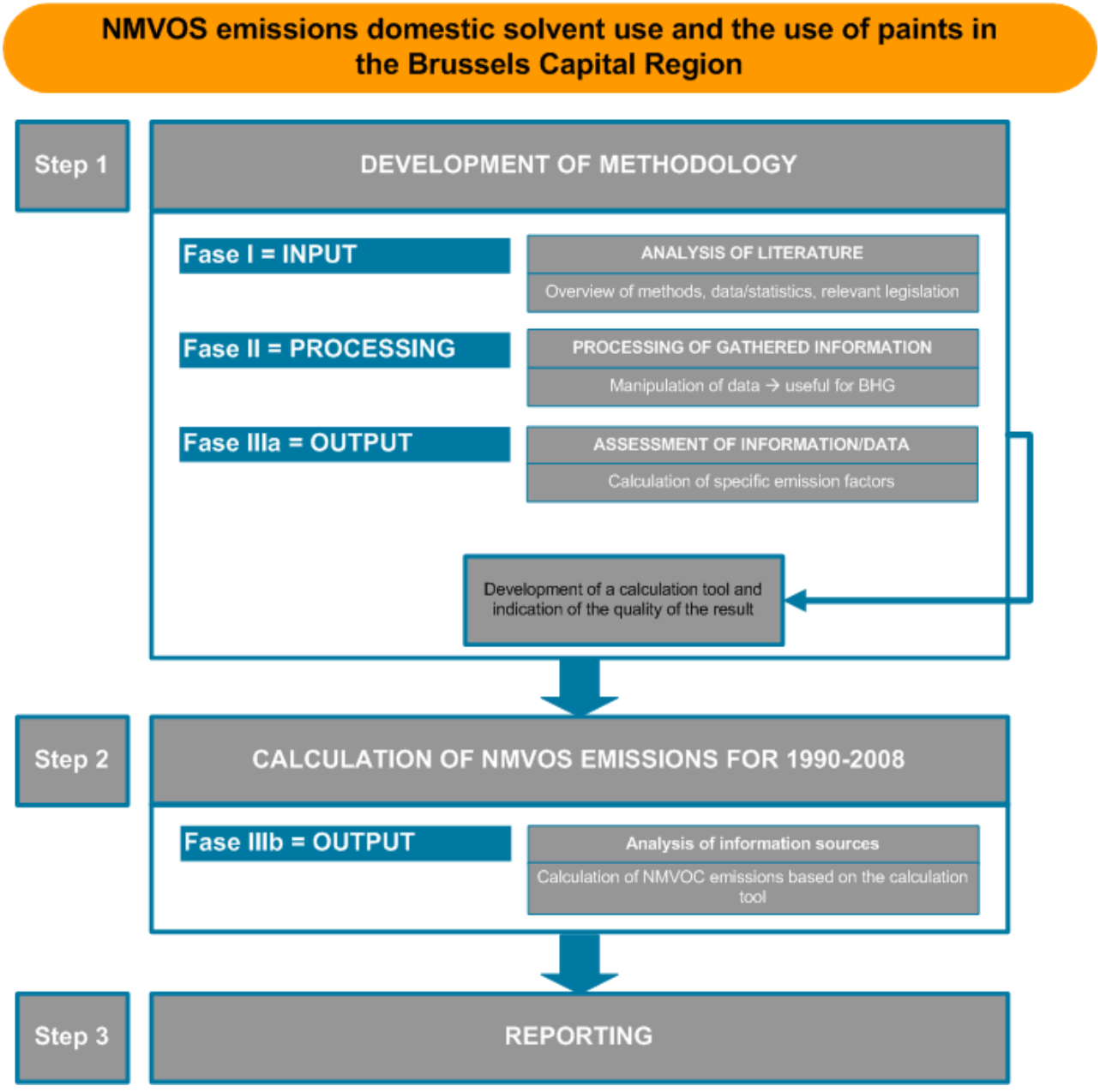
To be able to take the most appropriate measures to reduce the NMVOC emissions, the BCR needs to have an overview of the total emissions, the importance of individual source categories and the trends in emissions for those categories. A reliable NMVOC emission inventory is a first step in this process. The specific aim of this study is to estimate the NMVOC emissions in the BCR through the use of paints by consumers and professional users and the use of other solvents in households and that for:

- The current situation
- The period 1990-2007
- A future scenario

DESCRIPTION OF THE GENERAL WORK PLAN

The general work plan is shown in the following figure and contains three steps:

- Step 1: Development of a methodology (phase I, II and partly III)
- Step 2: Calculation of NMVOC emissions (partly phase III)
- Step 3: Reporting (phase IV)



The work plan is followed in the report by separating it in 2 main parts:

- Part 1: Overview of available information
- Part 2: Setting up an emission inventory for the BCR

.

PART 1 OVERVIEW OF AVAILABLE INFORMATION

1 METHODS USED IN DIFFERENT REGIONS/COUNTRIES

1.1 GENERAL GUIDELINES FROM EMEP / Corinair[2]

EMEP / Corinair has a long history and has first been developed in 1992. The guidebook has evolved over this period and has become an essential tool for compiling air emission inventories. The guidebook is intended to assist:

- Parties to the Convention on Long-Range Transboundary Air Pollution (LRTAP) meeting their emission reporting obligations under the Convention (adopted in 1979) and its protocols.
- Member States of the European Union to fulfil their emissions reporting requirements under the National Emissions Ceilings (NEC) Directive 2001/81/EC.

In addition the guidebook may be used to report some pollutants of relevance to the UN Framework Climate Change Convention (UNFCCC) and to other international bodies. The guidebook is compatible with, and complementary to, the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines). IPCC guidelines often refer to (links) other guidelines / information on methods. E.g. volume 1, sections 7.1 and 7.2 refer to EMEP / Corinair guidebook (Name is changed to EMEP/EEA Air Pollution Emission Inventory guidebook). The guidebook is also frequently used as a reference document by researchers. As such it is the most influential set of emission estimation methods used in air pollution studies in Europe and abroad.

The key elements of the methodology are briefly described in following paragraph.

1.1.1 Description of methodology

Pollutant emissions estimates are divided into sectors, categories and sources. The guidebook lists 11 different sectors, defined as groupings of related processes and sources. Sources of relevance for the scope of this study are to be found in the sector “Product use” and marked bold hereafter:

- **3.A: Paint application**
  - **3.A.1 Decorative coating application**
  - 3.A.2 Industrial coating application
  - 3.A.3 Other coating application
- 3.B: Degreasing and dry cleaning
  - 3.B.1: Degreasing
  - 3.B.2: Dry cleaning
- 3.C: Chemical products
- **3.D: Other product use**
  - 3.D.1: Printing
  - **3.D.2: Domestic solvent use including fungicides**
  - 3.D.3: Other product use

[2] EMEP/EEA air pollutant emission inventory guidebook 2009. Technical guidance to prepare national emission inventories. EEA Technical report n° 9/2009

New in the 2009 guidebook is the tiered methodology for estimating emissions. A tier represents a level of methodological complexity:

- Tier 1 methods apply a simple linear relation between activity data and emission factors. The activity data are derived from readily available statistical information (energy statistics, production statistics, traffic counts, population sizes, etc.). EMEP / EEA also lists default Tier 1 emission factors, which are chosen in a way that they represent 'typical' or 'averaged' process conditions — they tend to be technology independent.
- Tier 2 methods use the same or similar activity data to Tier 1 methods, but apply country-specific emission factors; country-specific emission factors need to be developed, using country-specific information on process conditions, fuel qualities, abatement technologies, etc. In many cases these methods could also be applied at a higher level of detail, where the activity statistics are further split into sub-activities (e.g. products within the scope of this study) with more or less homogenous process characteristics.
- Tier 3 methods go beyond the above; these may include using facility level data and/or sophisticated models. These methods are less common as suitable methods or sufficient reliable activity data or emission factors are often lacking.

The guidebook describes Tier 1 and Tier 2 methods for both NFR *3.A Paint application* and NFR *3.D Other product use*, the latter being valid for the three subdivisions. Tier 3 methods do not exist for these sources.

1.1.1.1 Paint application

The sources in paint application correspond to former SNAP activity codes:

- 060103, construction and buildings: this category refers to the use of paints for architectural application by construction enterprises and professional painters.
- 060104, domestic use: this category refers to the use of paints for architectural or furniture applications by private consumers. It is good practice not to include other domestic solvent use. However, it is sometimes difficult to distinguish between solvents used for thinning paints and solvents used for cleaning.

Tier 1: default approach

The default Tier 1 approach is to multiply the consumption of paint by an emission factor. The general equation is:

$E_{pollutant} = AR_{production} \times EF_{pollutant}$ where

$E_{pollutant}$ = the emission of the specified pollutant,

$AR_{production}$ = the activity rate for the paint application (consumption of paint),

$EF_{pollutant}$ = the emission factor for this pollutant.

This equation is applied at the national level, using annual national total figures for the consumption of paint. Information on the consumption of paint, suitable for estimating emissions using of the simpler estimation methodology (Tier 1 and 2), is widely available from UN statistical yearbooks or national statistics.

The Tier 1 emission factors assume an averaged or typical technology and abatement implementation in the country and integrate all different sub-processes in the chemical industry between feeding the raw material into the process and the final shipment of the facilities.

In cases where specific abatement options are to be taken into account, a Tier 1 method is not applicable and a Tier 2 or Tier 3 approach must be used.

The EMEP / EEA guidebook includes default Tier 1 emission factors for the different subcategories from source category 3.A Paint Application. The value proposed for 3.A.1 Decorative coating application is 150 g per kg paint applied and is a weighted average (old literature sources) for all countries in the GAINS-model (IIASA, 2008). The 95% confidence interval ranges from 100 to 400. For specific use in one country, it is worth considering that the own value will be influenced by e.g. the Decopaint directive 2004/42/EC (maximum values for 2007 and even more stringent in 2010), geography (different types of paints in Scandinavian compared to Mediterranean countries) and technological evolution. The on-line version of the GAINS model provides country-specific emission factors, which take into account this country-specific information: http://gains.iiasa.ac.at/gains/

Tier 2 technology specific approach

The Tier 2 approach is similar to the Tier 1 approach. To apply the Tier 2 approach, stratify the use of paint in the country to model the different process types occurring in the national paint use into the inventory by:

- defining the use of paint using each of the separate process types (together called 'technologies' in the formulae below) separately, and these **techniques** may include different products to be painted, the use of different paints (solvent borne, waterborne) or abatement techniques to reduce the emissions.
- applying technology-specific emission factors for each process type:

$$E_{pollutant} = \sum_{technologies} AR_{use,\ technologies} \times EF_{technology,\ pollutant}$$

Where :

$AR_{use,\ technology}$ = the use of paint within the source category, using this specific technology,

$EF_{technology,\ pollutant}$ = the emission factor for this technology and this pollutant.

If no direct activity data are available, penetration of different technologies within the paint application could be estimated from data on capacities, number of employees or other data that reflect the relative size of each of the different technologies.

Emission factors have been extracted from the IIASA GAINS model, similar to the Tier 1 emission factors. It must be noted that country-specific emission factors are available in the IIASA GAINS model. They are also available for various years (data for 1990, 2000 and 2010 from the European Council of producers and importers of paints, printing inks and artists' colours have been used) and may be used for an emission inventory for an individual country. These country- and year specific emission factors take into account country-specific information on implemented technologies and abatement measures and changes therein over time.

An emission factor of 230 g per kg paint used is proposed for the use of conventional solvent-based paints (50 weight % solvents), the 95 % confidence interval ranging from 100 to 300 g per kg paint. Tier 2 methodology aims to include "technologies" that are aimed at reducing the emissions of specific pollutants. This not only includes add-on abatement techniques, but also the use of paints with less solvents. The resulting emission can be calculated by replacing the technology-specific emission factor with an abated emission factor as given in the following formula:

$$EF_{technology,\ abated} = (1-\eta_{abatement}) \times EF_{technology,\ unabated}$$

When more than one abatement technique is applied (e.g. better paints and add-on techniques), it is good practice to subsequently apply these efficiencies to the applicable Tier 2 emission factor to derive the emission factor for the specific situation.

Table 1: Abatement techniques (efficiency) to correct emission factors proposed in the EMEP / EEA 2009 guidebook

Abatement technology	Efficiency (default)	Lower	Upper
Substitution with dispersion / emulsion (2-3 wt-% solvent)	39%	15%	63%
Substitution with water-based paints (efficiency 80%)	26%	0%	56%
Substitution with high solids paints (efficiency 40-60%)	4%	0%	43%
Substitution with dispersion / emulsion and water-based paints	65%	51%	79%
Substitution with dispersion / emulsion and high solids paints	43%	21%	66%
Substitution with dispersion / emulsion, water-based and high solids paints	70%	57%	82%

1.1.1.2 Domestic solvent use (SNAP 060408)

Tier 1 default approach

The Tier 1 method uses a single emission factor expressed on a per-person basis to derive an emission estimate for the activity by multiplying the emission factor by population.

Emission = Inhabitants X Emission factor

The Tier 1 emission factors assume an averaged or typical technology and abatement implementation in the country and integrate all different sub-processes within the source category. It is applied at a national level, using the national total domestic solvent use. In cases where specific abatement options are to be taken into account a Tier 1 method is not applicable and a Tier 2 or Tier 3 approach must be used.

The default value proposed amounts up to 1 kg per person per year (95% confidence interval between 0,5 and 3) and represents a weighted average of the emission factor for all the countries in the GAINS-model considered in 2000 (IIASA, 2008).

Tier 2 technology specific approach

The Tier 2 approach is equal to the one described for paints. To apply the Tier 2 approach, both the activity data and the emission factors need to be stratified according to the different domestic products with solvents that may be used in the country.

Possible emission factors are shown in Table 2.

Table 2: Emission factors from various regions used in EMEP / EEA guidebook 2009

Products	Region	Emission factor	95% confidence interval	
		(kg per person per year)	Lower	Upper
Cosmetics and toiletries	USA	1	0.5	1.5
Cosmetics and toiletries, non aerosol	UK	0.2	0.1	0.3
	Canada	0.4	0.2	0.6
Cosmetics and toiletries, aerosol	UK	0.5	0.2	0.8
	Canada	0.4	0.2	0.6
Household products	USA	0.4	0.2	0.6
Household products, non aerosol	UK, Canada	0.2	0.1	0.3
Household products, aerosol	UK	0.05	0.03	0.1
	Canada	0.3	0.2	0.5
Car care products	USA	0.6	0.3	1
Car care products, non aerosol	UK	0.3	0.2	0.5
	Canada	0.6	0.4	1
Car care products, aerosol	UK	0.1	0.05	0.2
	Canada	0.3	0.2	0.5
DIY buildings, adhesives	UK	0.07	0.04	0.1
	Canada	0.05	0.03	0.1
	USA	0.3	0.1	0.5
DIY buildings, other	USA	0.2	0.1	0.4
Aerosol propellant	UK	0.8	0.4	2

1.1.2 Discussion

A key issue of the EMEP / Corinair guidelines is the concept of key categories. A key category is a source category of emissions that has a significant influence on total emissions in terms of the absolute level of emissions, the trend in emissions over a given time period, or the uncertainty in the estimates for that party. The concept of key categories is an important aspect in inventory development in that it helps to identify priorities for resource allocation in data collection and compilation, quality assurance/quality control and reporting. Default emission factors from the general guidebook are however not considered to be key input for a country specific emission inventory. Aggregated emission factors could possibly be used to compare results from a specific bottom-up approach.

1.2 Current methodology used by BIM

NMVOC emissions from "the use of solvent containing products by members of the public and their homes"[3] are estimated based on following equation:

$$\text{Emission} = \sum_{p}\left(\text{Emission Factor}_{p} \text{ X Number of inhabitants}\right) \text{ where:}$$

- Emission = Emission of NMVOC in kg
- p = Type of product
- Emission Factor $_{p}$ = Emission per inhabitant for product type p (in kg NMVOC/inhabitant.year)

An emission factor of 1984 kg per inhabitant per year is used, based on a study by ECONOTEC/VITO study (2000) commissioned by the "*Federale Diensten voor het Leefmilieu*". This study aimed to prepare the federal policy on the reduction of the emissions of volatile organic compounds from VOC containing products. This emission factor is based upon Dutch values. This was argued by the fact that Dutch and Californian values were among the most recent available at that time. They had been regularly updated within the KWS2000 programme in The Netherlands. The Netherlands is a neighbouring country, with a similar climate and consumer behaviour The values for Belgium are however a mix between Dutch and Californian data, since total emissions in The Netherlands appeared to be quite low compared to other countries values. The choice for selecting those two countries was based on the fact that both inventories were detailed and recent and that both authorities were involved in emission reduction programmes concerning VOC emissions from household products, yielding regular surveys. The proposition of VOC emission levels for the domestic use of VOC containing products in Belgium (ECONOTEC/VITO, 2000) is given in Table 3.

In the Brussels emission inventory, an emission factor of 1984 g/inhabitant.year is estimated instead of the 2024 g/inhabitant.year as proposed for Belgium in Table 3. Reason for this is that emission from the use of carbolineum was not taken into account for Brussels. Carbolineum is a product used to impregnate wood surfaces in contact with water or placed in extreme climate conditions (facades, piles, …), mainly in rural areas. It was considered that carbolineum is not used in the Brussels Capital Region.

[3] Terminology as used in the document provided by BCR, summarising the methodology used by BIM (personal communication, 2010)

Table 3: Proposition of VOC emission levels for the domestic use of VOC containing products in Belgium (ECONOTEC/VITO, 2000)

VOC emissions from household product use	The Netherlands 1994 g/yr.pers	California 1997 g/yr.pers	Proposal Belgium g/yr.pers
Cosmetics and toiletries:	**454.2**	**800.3**	**699.5**
Deodorants	116.5	42.8	116.5
Hairsprays	304.7	469.9	304.7
Nail care products	16.5	19.2	16.5
After shave	5.0	11.6	5.0
Other products (inc. perfumes, alcohol, …)	11.5	256.8	256.8
Automobile products:	**207.6**	363.7	207.6
Auto wax & auto cleaner	21.5	38.0	21.5
Plastic care products	7.9	31.2	7.9
Window cleaner	132.4	93.9	132.4
De-icers	18.6	0.0	18.6
Other products	12.9	200.6	12.9
Aerosol paints	14.3	0.0	14.3
Cleaning products:	609.9	988.7	609.9
White spirit, paint thinners	233.8	548.7	233.8
Alcohol	118.2	77.7	118.2
Spot removers	136.8	0.0	136.8
Window cleaners	50.9	41.9	50.9
Hand cleaners	10.7	0.0	10.7
Air fresheners	9.3	93.0	9.3
Carpet cleaners	24.4	18.0	24.4
Other products	25.8	209.4	25.8
Office products:	19.5		19.5
Markers	9.7		9.7
Computer cleaners	5.3		5.3
Ball pens	4.4		4.4
Correction products	0.0		0.0
Pesticides	110.3	182.0	110.3
Glues and adhesives	304.9	141.4	304.9
Leather and furniture:	32.4	145.1	32.4
Shoe shine and leather protection	14.3	11.3	14.3
Furniture care			
Other products	11.2	24.4	11.2
	6.9	109.4	6.9
Carbolineum	19.5		40.0
BBQ products		52.4	
TOTAL	**1 758.2**	**2 673.6**	**2 024.1**

Following issues are important to take into consideration in this study:

- The data chosen for The Netherlands date from 1994, before the impact of emission reduction initiatives.
- The data, as presented, in Table 3 are the result of enquiries conducted in The Netherlands and California but could not be compared with detailed statistics for Belgium (since such detailed data were not available at that time). Available statistics for Belgium have been considered only for a qualitative evaluation of choices that were made.
- The fact that for deodorants the EF is much lower in California than in The Netherlands (42,8 compared to 116,5) can be due to the fact that California used alternative definitions of VOC and that they don't consider C_2H_5OH (ethanol) as a NMVOC.
- Emissions from the domestic use of paint are not included

1.3 Description of methods used in other regions/countries

1.3.1 Flemish region

In the Flemish emission inventory (Anoniem, 2009), NMVOC emissions are reported for:

- Domestic use of paint
- Domestic use of other solvents

1.3.1.1 Domestic and architectural use of paint

The following equation is used to calculate NMVOC emissions from the non-industrial use of paint in Flanders.

Emission = $\{A_{DP} \times [(F_S \times SC_S) + (F_W \times SC_W)]\} / INH_B \times INH_{FL}$ where:

- Emission = Emission of NMVOC in kg
- A_{DP} = Total sales of Decorative Paint in Belgium [kg]
- F_S, F_W = Fraction of solvent-based and water-based paint in total paint sold [-]
- SC_S, SC_W = Solvent Content of solvent-based and water-based paint [kg solvent/kg paint]
- INH_B, INH_{FL} = Number of INHabitants in Belgium and FLanders

Total sales of decorative paints are provided by IVP. This figure is based on the sales data of IVP members, which have a market share of about 85% in total sales in Belgium (source: IVP). The conversion factor from liter to kg paint is 1.2 kg paint/liter.

The fraction solvent- and water-based paint (F_S, F_W) is derived from total sales data and calculated annually. For 2007 fractions are 0.3 and 0.7 respectively (source: IVP). The solvent content of solvent- and water-based (SC_S, SC_W) paint is assumed to be 0.48 and 0.065 respectively (source: IVP based on personal communication of CEPE).

The factor "INH_B/INH_{FL}" is used to estimate emissions for Flanders only, based on sales data for Belgium. It is assumed that the use of domestic and architectural paint is related to the number of inhabitants.

The split of emissions over "domestic" and "architectural use" is based on the estimations in RAINS[4] (33.8% and 66.2% respectively for 2008) and contains a high uncertainty.

1.3.1.2 Domestic use of other solvents

The following equation is used to calculate NMVOC emissions from domestic use of solvent containing products.

$$\text{Emission} = \sum_p \left(\text{Emission Factor}_p \text{ X Number of inhabitants} \right)$$ where:

- Emission = Emission of NMVOC in kg
- p = Type of product
- Emission Factor $_p$ = Emission per inhabitant for product type p (in kg NMVOC/inhabitant.year)

The emission factor from The Netherlands (1994) of 1758 g per inhabitant per year is used (cf. Table 3)

[4] RAINS is the Regional Air Pollution Information and Simulation model, developed by IIASA

1.3.2 Walloon region

SPW Wallonie uses the following equation for estimating the emissions of NMVOC due to **domestic use of solvents (SNAP 060408)**:

$$\text{Emission} = \sum_{p}\left(\text{Emission Factor}_{p} \text{ X Number of inhabitants}\right)$$ where:

- Emission = Emission of NMVOC in kg
- p = Type of product
- Emission Factor $_p$ = Emission per inhabitant for product type p (in kg NMVOC/inhabitant.year)

The emission factor used is 2024 g per inhabitant per year (cf. Table 3). This is the emission factor, proposed for Belgium in a study on the preparation of a policy to reduce the emissions of VOC from products (VITO and Econotec, 2000).

For the Walloon Region, the VOC emissions from domestic use of solvents are estimated to be about 7 ktons for 2008.

NMVOC emissions **due to the use of paint** is estimated based on the exact same method as in the Flemish region (cf. chapter 1.3.1.1). Of course the number of inhabitants in the Walloon Region is taken into account here to estimate emissions for the Walloon Region based on input data relevant for Belgium.

1.3.3 The Netherlands

In the Dutch emission inventory (www.emissieregistratie.nl (ER), 2010), NMVOC emissions are reported for:

- Car products
- Domestic use of pesticides
- Cosmetics and personal care products
- Office goods and leather care products
- Cleaning products
- Paint

ER uses the following equation:

Emission = $\left(\sum(A_P \times SC_P)\right) \times RF$ where:

- Emission = Emission of NMVOC in kg
- A_P = Total sales of product P in The Netherlands
- SC_P = Solvent Content of product P [kg solvent/€, l, kg…]
- RF = Regionalising Factor to allocate total emissions to different regions in The Netherlands

Total sales of different products are collected through questionnaires via marketing offices (e.g. CREM for car products), important producers, industry associations (e.g. NCV for cosmetics, NVZ for soap, VVVF for paint). The solvent contents are also collected through these questionnaires. Detailed results of those questionnaires are however not publicly available.

The Regionalising factors used are;

- For car products (like cockpit sprays, wax, …), cosmetics, office goods; leather care products, cleaning products and paint: population density
- For mobile car products like de-icing and window cleaners: traffic density

Special assumptions

For denatured alcohol (or spiritus), in the category “cleaning products”, it is assumed that 38% of the used of amount will end up in the air, the other 62% is burned (BBQ or fondue) or is emitted to the sewage system and degraded in sewage treatment plants. For hand soap it is assumed that only 50% is emitted to air and the other 50% is emitted to water.

Ammonia is also categorised as a cleaning product, but is not a NMVOC.

The solvents used to dilute paint, bought in drugstores or DIY-stores are also included in the emissions from paints used in households.

ER NL also breaks down total NMVOC-emissions to emissions of individual NMVOCs (propane, isobutene, toluene, …).

1.3.4 France

The OMINEA report (**O**rganistation et **M**ethodes des **I**nventaire **N**ationaux des **E**missions **A**tmoshheriques en France) includes a description of the national inventory system (used in France) of pollutant emissions into the atmosphere (SNIEPA) (CITEPA, 2009). The inventory is based on the international reporting format defined by the United Nations within the framework of conventions on climate change and long range transboundary air pollution (CRF/NFR).

Emissions are estimated for “Domestic use of solvents” and include domestic use of paints, adhesives, solvents and pharmaceutical products.

The calculation is based on the following equation **for paints and adhesives**:

Emission = Consumption_P X Emission factor_P where:

- Emission = Emission of NMVOC in kg
- p = adhesives or paint
- EF = NMVOC Solvent content of the product p

The calculation is based on the following equation **for other solvents and pharmaceutical products**:

Emission = Inhabitants X Emission factor_P where:

- Emission = Emission of NMVOC in kg
- p = domestic use of pharmaceutical products or other solvents
- EF = Emission of NMVOC per inhabitant per year

The Emission factors used are shown in Table 4.

Table 4: Emission factors used in the French emission inventory (CITEPA, 2009)

Activity	Unit	1990	1995	2000	2005	2007
Use of paint	kg NMVOC/ton paint	250	220	190	170	150
Use of adhesives	kg NMVOC/ton adhesive	135	95	80	63	53
Use of pharmaceutical products	g NMVOC/inhabitant	62.8				
Use of other solvents	g NMVOC/inhabitant	1600				

1.3.5 Sweden

In 2005 a new method for estimating emissions from Solvent and Other Product Use was developed by the Swedish Meteorological and Hydrological Institute (Skårman et al., 2006) in cooperation with the Swedish Chemicals Agency. The method is more complete, accurate and transparent and data can easily be updated on a yearly basis. The methodology is consumption-based with a product related approach. All primary data is derived from the Products Register at the Swedish Chemicals Agency. The model has a lot of similarities with the German model.

Activity

Sales = production + import – export

Emission

E = activity data x emission factor

In several studies, Sweden has developed emission factors in order to adjust to the old time series 1988–2001. The factors take into account different application techniques, abating measures and alternative pathways of release (e.g. to waste or water). As an example, in industries where most of the solvents are used in aqueous solutions, an emission factor of 10% is used. For emissions to air two emission factors have been developed for each activity: one for solvents used as a raw material and one for the remaining quantities. The emission factors for raw material have been set very low, since most of the solvents will end up in products and will hence not be emitted during the production process.

These country specific emission factors apply to 12 different industries or activities which correspond to subdivisions of the four major emission source categories for solvents used in international reporting of air pollution (European Environment Agency, 2007 in Holmengen & Kittilsen, 2009).

Sweden does not compile and report data on detailed SNAP or GAINS level and consequently domestic use is not estimated separately in the Swedish inventory. Due to confidentiality, data from the Swedish Products Register can not be delivered on substance level. Hence it can not be derived from the model what substances are included or dominating for domestic use in Sweden.

When calculating the emissions of NMVOC, an emission factor of 0.95 kg NMVOC/kg product is used. Only for anti-freeze products the emission factor is set to 0.1 kg NMVOC/kg product.

1.3.6 Germany

In Germany they use a consumption-based method with a product related approach (Theloke, J., Friedrich, R., 2003) when calculating emissions of NMVOC from Solvent and Other Product Use. In the method they

use the NMVOC definition stated in the Council directive 1999/13/EC of March 1999[5]. The German method includes the following steps:

1. The use of solvents and solvent based products are derived from production statistics and foreign trade statistics (production + import - export)
2. The use of the solvents and solvent based products in each specific industrial and commercial sector and in households are estimated.
3. The emission factors are developed in consideration of application techniques, emission control measure and other pathways of NMVOC release (e.g. waste, water, recycling).

1.3.7 Norway

In 2007, Statistics Norway (Holmengen & Kittilsen, 2009) developed a revised method for emission calculation for NMVOCs from the use of solvents and other products. The results will be used for reporting from the year 2008 onwards.

Previously, statistics on export, import and production were used, whereas the basic data source in the revised method is the Norwegian Product Register. These data include information on a substance level of the product type into which the substance enters and the (industrial) sector in which the product is used (including private households). Because the data are available on a substance level, no assumptions about solvent content need to be made.

The substance list used in the Swedish NMVOC inventory (Skårman et al, 2006) was used as a basis. This substance list is based on the definition stated in the UNECE Guidelines[5].

The general model is a simplified version of the detailed methodology described in the EMEP/CORINAIR Guidebook 2007 (European Environment Agency, 2007). It represents a mass balance per substance, where emissions are calculated by multiplying relevant activity data with an emission factor, according to the following equation:

Emission = consumption x emission factor (fraction emitted)

Consumption = production + import - export

The general model can be modified so as to integrate information on the life cycle of different products. For some products data are available on the fraction converted into other chemical compounds or the fraction destroyed during waste treatment. This can be expressed through variations of the simple equation, e.g.:

Emission = consumption x (1 - (factor1 + factor2 + factor3)) where:

- factor1 is the fraction converted to other chemical compounds
- factor2 is the fraction that becomes part of a new product (without being converted)
- factor3 is the fraction destroyed during waste management.

NMVOC emissions from domestic use of solvents and solvent containing products are associated with high uncertainties, due to the diverse use and release patterns and the vast number of solvent containing products. Domestic use is diffuse i.e. the emissions are wide-spread and are not controlled by collection of solvent vapours. A discussion between the Nordic countries (Fauser et al., 2009) focused a.o.

[5] "Volatile organic compound (VOC) shall mean any organic compound having at 293.15º K a vapour pressure of 0.01 kPa or more, or having a corresponding volatility under the particular conditions of use. For the purpose of this Directive, the fraction of creosote which exceeds this value of vapour pressure at 293.15º K shall be considered a VOC."

on the allocation of emission factors to solvent use and use of solvent containing products, which has a high potential uncertainty.

The emission factors for Norway are specific for the combination of product type and (industrial) sector (with private households as a separate sector), and are mainly gathered from two Swedish reports. A few adjustments had to be made, e.g. the emission factor for anti-freezing agents from the Swedish model was only used for commercial land, water and air transport (NACE 60-62) (value of 0.1). However, when anti-freezing agent must be refilled in a private car, this entails part of it evaporating or being emitted otherwise. Therefore, the emission factor for anti-freezing agents was set higher in the Norwegian model (value of 0.95).

Emission factors may change over time, and such changes may be included in this model. However, all emission factors were considered constant over the 2005 to 2007 period.

The quality of the Product Register data was improved by reducing the use of quantity intervals, dealing with uncertainty in emission factors and activity data based on Swedish experience.

For products containing only small amounts of solvents, no declaration to the Product Register is required. In such cases, data from the trade and manufacture statistics can be included. A separate **cosmetics model** was built to complement the available information.

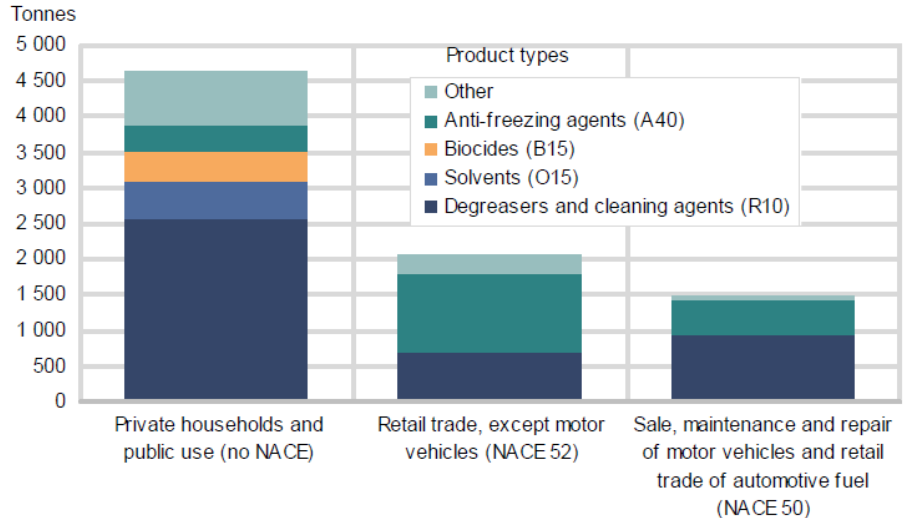
The Norwegian Pollution Control Authority calculated the consumption of pharmaceuticals and cosmetics in 2004, based on sales figures (given in Norwegian kroner) from the Norwegian Association of Cosmetics, Toiletries and Fragrance Suppliers (KLF) and Swedish turnover numbers (given in tonnes) (Norwegian Pollution Control Authority 2005). The consumption was calculated for product groups such as shaving products, hair dye, body lotions and antiperspirants. A consumption time series (in tonnes) from 2005 to 2007 was calculated from the relationship between consumption in Norwegian kroner and in tonnes in 2004, and a consumption (in Norwegian kroner) from 2005 to 2007 from KLF (Norwegian Association of Cosmetics Toiletries and Fragrance Suppliers (KLF 2008)). Figures on VOC content and emission factors for each product group were taken for the most part from a study in the Netherlands (IVAM 2005), with some supplements from the previous Norwegian solvent balance (the previous NMVOC model). Because of lack of data on distribution of cosmetics consumption over sectors, the emissions were divided equally between the sectors private households (no NACE) and “Other personal services” (NACE 93), where sectors such as hairdressers and beauty salons are included.

Water-based paint on the other hand, can contain some organic solvents, but the solvent content is below the limit for the duty of declaration to the Product Register and labelling to apply, but the consumption volumes are so large that these products might constitute a considerable source of NMVOC emissions. However, as of now, these emissions are considered minor, compared to the estimates for other product groups included in the Product Register data.

Emission results

Domestic solvent use (NFR category 3D iii) includes emissions from solvents and other products deemed to be consumed in private households. This includes products declared used in retail sale of automotive fuel (NACE 50.5), retail trade (except motor vehicles) (NACE 52), recreational, cultural and sporting activities (NACE 92), private households and for public use (no NACE). The most important product types are degreasers and cleaning agents, anti-freezing agents, biocides and solvents (Figure 3). the most dominant substances are ethanol and ethylene glycol.

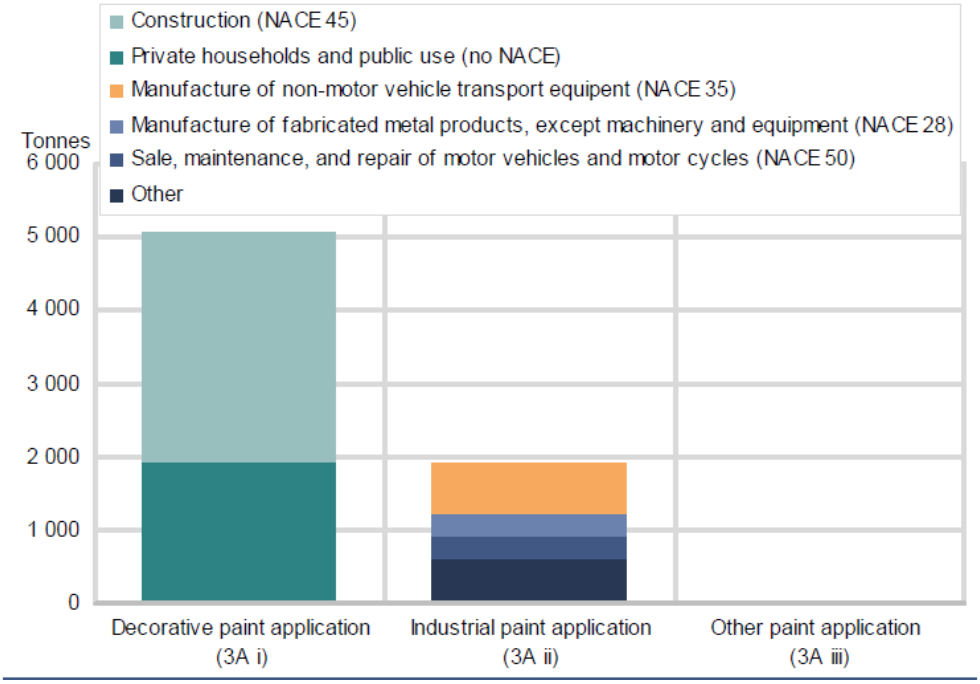
Figure 3: NMVOC Emissions from most important product types within each sector in NFR extention 3Diii, 2007 in Norway (in tonnes) (Ref: Holmengen and Kittilsen, 2009)



The emissions of NMVOC from paint application (industrial as well as domestic use) have been quite stable between 1989 and 2007. There was a decrease from 2005-2007, presumably due to a shift towards water-based paint and varnish, and consequently a lower consumption of solvent-based products.

Decorative paint application (NFR extension 3A i) is by far the largest of the three extensions within the NFR paint source codes (Figure 5.2). Paint and varnish used in construction (NACE 45), in private households and for public use (no NACE) is allocated to this NFR code. The consumed amount in decorative paint application (NFR extension 3A i) and industrial paint application (NFR extension 3A ii) were approximately the same in 2007, and the difference in emissions is due to different emission factors.

Figure 4: NMVOC Emissions in NFR extensions 3Ai-iii by (industrial) sector in 2007 in Norway (in tonnes) (Ref: Holmengen and Kittilsen, 2009)



1.3.8 Denmark

1.3.8.1 Description of methodology (Fauser *et al*, 2009)

Since 2003, the detailed method described in the EMEP/CORINAIR Guidebook has been used.

For each substance the following mass balance is formulated:

Consumption = production + import – export – destruction/disposal – hold-up

Production figures are reported quarterly as "industrial commodity statistics by commodity group and unit", from 1995 on.

Import and export figures are available on a monthly basis from 1995 onwards and contain trade information with 272 countries worldwide.

Destruction and disposal of solvents lower the NMVOC emissions. In theory, this amount must be estimated for each NMVOC in all industrial activities and for all uses of NMVOC containing products. At present, the solvent inventory only considers destruction and disposal for a limited number of NMVOCs. For some NMVOCs it is inherent in the emission factor and for others the reduction is specifically calculated from information obtained from the industry or literature.

Hold-up is the difference in the amount in stock in the beginning and at the end of the year of inventory.

For each substance:

*Emission = Consumption * Emission Factor*

Emission factors represent specific industrial activities or use categories (e.g. paints and detergents). Some substances have been assigned emission factors according to their water solubility. Higher hydrophobicity yields higher emission factors, since a lower amount ends up in waste water, e.g. ethanol (hydrophilic) and turpentine (hydrophobic).

Emission factors vary considerably between substances, even for the same source category. They are categorised in four groups in ascending order:

- Lowest emission factors in the chemical industry (e.g. lacquer and paint manufacturing) due to emission abatement techniques and destruction of solvent containing waste
- Other industrial processes (e.g. graphic industry) have higher emission factors
- Non-industrial use (e.g. car repair and assembly) have still higher emission factors
- Diffuse use of solvent containing products (e.g. paint) where all the NMVOC present in the products will be released during or after use

For a given substance, the consumed amount can thus be attributed to two or more emission factors: one emission factor representing the emissions occurring at a producing or processing plant and one emission factor representing the emissions during the use phase of a solvent containing product. If the substance is used in more processes and/or is present in several products, more emission factors are assigned to the respective substance.

Products exclusively for private use do not need to be registered e.g. pharmaceuticals and cosmetic products (and are therefore not included in the inventory).

For domestic use SNAP 060104 (Paint Application: Domestic Use except 060107) (id=5 and 6), SNAP 060408 (Other: Domestic Use other than paints) (id=70 to 74) and SNAP 060411 (Other: Domestic Use of Pharmaceutical Products) (id=76 and 77) emission factors are defined on a substance level.

1.3.9 Finland and Iceland

1.3.9.1 Description of methodology

The Finnish and Icelandic methods are not based on NACE and use category codes (UCN). Therefore, information is only available with respect to emission factors in relation to the general coding.

The Finnish solvent sector inventory is based on emission data, activity data and emission factors received from various sources, all specific to the respective source categories:

- Id 1-25: emission factors are not available; information is included as emission data from the reports by operators and information from surveys
- Id 70-77: emission factors are not available; only emission data reported by industrial associations are included

The Finnish shares of domestic releases in the solvent use sector are estimated as follows:

- Domestic use of solvent-based paints equals to 30% of NMVOC emissions in NFR 3A (information from the Association for Finnish Paint Industry)
- Domestic solvent use equals to 50% of NMVOC emissions in NFR 3D (information from the Finnish Environment Institute)

The Finnish emission inventory includes the following relevant sources under NFR reporting category 3D “Other product use”:

- Emission data from preservation of wood (SNAP 060406) is included in the inventory based on statistical data and calculations at the inventory agency.
- Emission data on domestic solvent use (SNAP 060408) are included in the inventory based on emission data estimated by Finnish Technochemical Association. However, the estimates are regarded as outdated.
- Another category (SNAP 060412) includes e.g. pesticide use, preservation of seeds and some industrial plants

The following categories are not included in the inventory:

- Application of glues and adhesives (SNAP 060405) because of a lack of activity data
- Domestic use of pharmaceutical products (SNAP 060411) is not included in the inventory because no method has been developed yet
- Vehicles dewaxing (SNAP 060409) is not included in the inventory

In Iceland only import figures are relevant, because there is no production, nor export. Iceland has not developed country specific emission factors, but assumes that 100% NMVOC is emitted to the atmosphere.

2 INTERNATIONAL REPORTING OBLIGATIONS

Within international conventions, reporting of inventories of air emissions and sinks is required for all Parties. Keeping the aim of the underlying study in mind (emissions due to the use of solvent containing products and paints), following conventions, of which European Union (EU) Member States as well as the European Community are Party can be mentioned as relevant for the study (with an overview of gases and pollutants to be reported):

UN "Framework Convention on Climate Change" (UNFCCC), assisted by IPCC: CO_2, CH_4, N_2O, NOx, NMVOC, CO, HFCs, PFCs and SF6 (by 15 April for the last but one year).

NFR (New Format Reporting) of the UNECE-Convention on Long-Range, Transboundary Air Pollution (UNECE/CLRTAP) replaces the EMEP report. It is based on similar categories as used with UNFCCC report, instead of SNAP sectors used in the EMEP report.

The EU furthermore requests its Member States to report the same data that are reported to UNFCCC, by means of the EU Monitoring Mechanism on greenhouse gases, to the European Commission (by 31 December for the last year). The EEA assists the Commission in evaluating these inventories. Furthermore the EEA assists the Commission in preparing the European Community submission of greenhouse gas inventories (EU totals).

The reporting requirements for each of the two conventions NFR of UNECE/CLRTAP and UNFCCC CRF (Common Reporting Format) are different however source categories used are quite similar (based on IPCC categories) but with various levels of aggregation:

On the highest level of aggregation UNFCCC (IPCC/CRF format) uses 6 source and sink categories (with approximately 25 more detailed sub-categories) in accordance with the 1996 IPCC Guidelines. Recently it has been decided to use a new Common Reporting Format (CRF) for delivering emission inventories to the UNFCCC.

NFR (New Format Reporting) of UNECE/LRTAP uses 6 main source categories similar to categories used with UNFCC CRF report. Base categories can be split up to 5 levels (inclusive top level).

In the future, information on releases from diffuse sources (for example solvent use) shall be included in the reporting to UNECE-Aarhus Convention Protocol on Pollutant Release and Transfer Registers (PRTR). The NMVOC emission inventories from solvent use are also included in the greenhouse gas (GHG) emission inventories.

The Task Force on Emission Inventories is responsible for developing and maintaining the EMEP/CORINAIR Emission Inventory Guidebook used for the estimation and reporting of national emissions. The Task Force also maintains the air pollution source-category nomenclatures NFR (Nomenclature For Reporting) and SNAP (Selected Nomenclature for Air Pollution).

2.1 Description

2.1.1 UNECE EMEP/LRTAP

According to the EMEP 2002 Reporting Guidelines, NFR formats cover seven groups:

1. Energy
2. Industrial processes
3. Solvent and other product use

4. Agriculture
5. Land-use change and forestry
6. Waste
7. Other

Relevant categories are (CEIP – Convention on Emission Inventories and Projections, 2009):

- Solvents and other product use
- 3A Coating application
- 3A1 Decorative Coating application (domestic and architectural)
- 3A3 Other coating application
- 3D Solvent use
- 3D2 Domestic Solvent use and fungicides

Besides emissions, activity data also need to be reported:

- for 3A1: paint applied in ktons
- for 3D2: solvent used in ktons

The SNAP Nomenclature was originally developed for the 1985 EC CORINAIR emissions inventory (SNAP94) and has been revised several times to ensure compatibility between EMEP/CORINAIR and IPCC. It was recently revised (SNAP2007) (http://reports.eea.europa.eu/EMEPCORINAIR5/en/page015.html).

Link to SNAP:

- SNAP 060103 Non industrial use of paints: architectural use of paints – Decorative paints
- SNAP 060104 Paint application – domestic use (except 060107 – wood)
- SNAP 060109 Other non-industrial paint application
- SNAP 060408 Domestic solvent use
- SNAP 060411 Domestic use of pharmaceutical products

2.1.2 UNFCCC

CRF is designed to ensure that Parties included in Annex I to the Convention (Annex I Parties) report quantitative data in a standardised format, and to facilitate the comparison of inventory data across Annex I Parties. The information provided in the CRF is aimed at enhancing the comparability and transparency of inventories by facilitating, inter alia, activity data and emission factors cross-comparisons among Annex I Parties, and easy identification of possible mistakes, misunderstandings and omissions in the inventories (http://unfccc.int/files/meetings/cop_11/application/pdf/cop11_09_8_tables_of_the_common_reporting_format_for_luluc.pdf).

- 3 Solvents and other product use
  - 3A Paint application
  - 3D Other
    - 3D5 Other (specified)

2.1.3 RAINS/GAINS

The Regional Air Pollution Information and Simulation (RAINS/GAINS) model developed by the International Institute for Applied Systems Analysis (IIASA) combines information on atmospheric emissions with a number of other economic, energy and environmental parameters. These air pollution related problems are considered in a multi-pollutant context, quantifying the contributions of, inter alia, NMVOCs. The source categories of the RAINS/GAINS model are not directly compatible with that of SNAP/CORINAIR or NFR.

2.2 Linking of codes

No linking of all codes has been agreed upon yet in an international context. In Fauser et al. (2009) a suggestion for defining domestic use in terms of category codes has been presented after a discussion between the five Nordic countries.

A list linking SNAP/CORINAIR, CRF, NFR, RAINS/GAINS and NACE industrial use is suggested for the solvent use sector. The table has been agreed by the experts responsible for performing the emission inventories for solvent use in the Nordic countries. The list is designed for an ideal situation, assuming that all codes are used and that there are no country specific limitations in data availability. The “id” is a unique running number, representing a specific combination of codes.

The following ids are relevant for the solvent use looked at in the framework of this report:

- SNAP 060103 Construction and buildings refers to non industrial use of paints: architectural use of paints – Decorative paints in the following sectors:
  - NACE 45 Construction (id 3) and
  - NACE 51 Wholesale trade and commission trade, except of motor vehicles and motorcycles (id 4)
- SNAP 060104 Non industrial use of paints: domestic use of paints is included in NFR 3A1 “Decorative paint application”) in the following sectors:
  - Private households (id 6) and
  - NACE 52 Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods (id 5)
- SNAP 060408 Domestic solvent use (other than paint application) is included in NFR 3D2 “Domestic solvent use including fungicides” in the following sectors:
  - Private households (id 70)
  - NACE 20 Wood industry (id 67, 68 - biocides, impregnation, raw materials and viscosity changers)
  - NACE 50 (id 69 - degreasers, rust inhibitors)
  - NACE 52 Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods (id 72)
  - NACE 50.5 Retail sale of automotive fuel (id 71 e.g. antifreeze)
  - NACE 92 Recreational, cultural and sporting activities (id 73)
  - NACE 93.02 Hairdressing and other beauty treatment and 93.05 Other services activities n.e.c.
- SNAP 060411 Domestic use of pharmaceutical products is included in NFR 3D iv “Other including products containing HMs and POPs” in the following sectors
  - Private households (id 76)

    NACE 50, 52 (id 77)

3 RELEVANT LEGISLATION

3.1 Cosmetics Directive 76/768/EC

The Directive sets out a list of substances which cannot be included in the composition of cosmetic products (Annex II) and a list of substances which cosmetic products may contain only under the restrictions and conditions laid down in Annex III. The Directive also sets out conditions for labelling of cosmetic products. Moreover, the label must contain a list of ingredients, *in descending order*, preceded by the word "Ingredients".

The Directive has been amended and adapted several times. In 2003, a modification was introduced entering into force in 2004, providing that the public can have access to certain information from cosmetic companies on request. This increased transparency concerns:

- composition of the cosmetic product;
- undesirable effects that may have been reported to companies regarding products they produce.

Quantitative and qualitative information is required concerning the composition of the product. The obligation to make quantitative information publicly accessible is limited to dangerous substances covered by Directive 67/548/EEC. Colipa, the European Cosmetic Toiletry and Perfumery Association, has set up a specific database to facilitate public access to relevant information.[6] This database does not contain information on the composition but rather makes it possible for the public to get in contact with the manufacturers.

On 30 November 2009, a new Cosmetic Products Regulation 1223/2009 was adopted replacing the Cosmetics Directive. The Regulation is mainly intended as a simplification of the current Directive. Most of the provisions of this new regulation will be applicable as from 11 July 2013. The provisions on acces to information for the public are taken up in article 21.

Discussion

The legislation on cosmetics sets out different requirements concerning the use of ingredients and information on the composition of the product. The information requirements are however not sufficient in order to be used within this project. Quantitative information on the use of ingredients is known per specific product only if the ingredient is classified under 67/548/EEC.

3.2 VOC Solvents emissions Directive 1999/13/EC7

The VOC Solvents Emissions Directive is the main policy instrument for the reduction of industrial emissions of volatile organic compounds (VOCs) in the European Union. It covers a wide range of solvent using activities, e.g. printing, surface cleaning, vehicle coating, dry cleaning and manufacture of footwear and pharmaceutical products. The VOC Solvents Emissions Directive requires installations in which such activities are applied to comply either with the emission limit values set out in the Directive or with the requirements of the so-called reduction scheme.

The Original VOC Solvents Emissions Directive has been amended through article 13 of the Paints Directive (Directive 2004/42/EC). The amendment removed a subactivity of "Vehicle Refinishing" from the scope of the VOC Solvents Emissions Directive, as the "vehicle refinishing products" fall under the scope of the Paints-Directive (Directive 2004/42/EC).

Discussion

[6] http://www.european-cosmetics.info/site/index.cfm?SID=14075
[7] http://ec.europa.eu/environment/air/pollutants/stationary/solvents.htm

The Directive does not cover activities related to domestic solvent use nor the use of paint targeted in this study. It is worth remarking that some activities are neither covered by the solvents Directive nor by the paints Directive, e.g. small carpenters where paint use is largely below the threshold value.

3.3 VOC paints directive 2004/42/EC

The Directive aims to prevent the negative environmental effects of emissions of volatile organic compounds (VOCs) from decorative paints and vehicle refinishing products. The products covered by the Directive are paints for use on buildings, their trims and fittings and structures associated to buildings and products for vehicle refinishing. The specific subcategories of products covered are listed in Annex I of the Directive.

For the paints, the Directive sets up two sets of limit values for the maximum contents of VOCs in grammes per litre of the product ready for use. The first set of limit values started to apply from 1 January 2007. The second, and stricter, set of limit values applies since 1 January 2010. For vehicle refinishing products there is only one set of limit values for the VOC contents, which applies from 1 January 2007. The latter are not relevant within the scope of this study.

Product categories falling within the scope of the Directive can be marketed in the EU only if they comply with the specifications (limit values) of Annex II. Such products must be labelled when placed on the market. Articles 6 stipulates that Member States need to develop a market surveillance system to verify the VOC content of the products covered by this Directive. Some key elements on the first Member states monitoring reports are briefly described in the next paragraph 3.4.

The limit values of Annex II of the Directive are listed in the table below:

Table 5: Limit values in Directive 2004/42/EC

	Product Subcategory	Type	Phase I (g/l (*)) (from 1.1.2007)	Phase II (g/l (*)) (from 1.1.2010)
a)	Interior matt walls and ceilings (Gloss <25@60°)	WB	75	30
		SB	400	30
b)	Interior glossy walls and ceilings (Gloss >25@60°)	WB	150	100
		SB	400	100
c)	Exterior walls of mineral substrate	WB	75	40
		SB	450	430
d)	Interior/exterior trim and cladding paints for wood and metal	WB	150	130
		SB	400	300
e)	Interior/exterior trim varnishes and woodstains, including opaque woodstains	WB	150	130
		SB	500	400
f)	Interior and exterior minimal build woodstains	WB	150	130
		SB	700	700
g)	Primers	WB	50	30
		SB	450	350
h)	Binding primers	WB	50	30
		SB	750	750
i)	One-pack performance coatings	WB	140	140
		SB	600	500
j)	Two-pack reactive performance coatings for specific end use such as floors	WB	140	140
		SB	550	500
k)	Multi-coloured coatings	WB	150	100
		SB	400	100
l)	Decorative effect coatings	WB	300	200
		SB	500	200

(*) In g/l ready to use

Transposition in Belgian legislation, KB, 7/10/2005 = +/- Translation of the European Directive

3.4 Monitoring reports

Article 6 of the paints Directive 2004/42/EC requires Member States to set up a monitoring programme in order to verify compliance with the Directive. The results of the monitoring programme must be reported to the Commission at regular intervals. The first report was due July 2008. As foreseen in Article 7 of the Directive, a "common format" for reporting has been established by Commission Decision C(2007) 1236 of 22 March 2007.[8] The second report is due 18 months after the instalment of the stricter 2010 limits at the end of June 2011.

Several reports[9] have been screened in order to identify relevant elements for this study, with specific attention for Belgium and the neighbouring countries France, Germany and the Netherlands. Information on the monitoring programs and the obtained results are described below. The standard format for reporting also asks to provide information on the main difficulties encountered in setting and implementing the monitoring programme. Several Member States report problems assigning products to specific product categories, mainly because of the large number of products. Belgium specifically mentions the open market which makes it very difficult to determine the quantities sold on the Belgian market.

[8] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:091:0048:0051:EN:PDF
[9] http://ec.europa.eu/environment/air/pollutants/paints_ms_reporting.htm

Monitoring program

It is asked to provide a written version of the monitoring program when available. The standard format also foresees a brief description of the specific approach. Written monitoring programmes are only mentioned by the Netherlands and Germany for certain *Bundesländer*. Other Länder apparently have integrated the monitoring in the programme for monitoring the chemicals legislation. Only the monitoring program of the Netherlands has been found through internet search.

Member States describe the type of operators that are inspected, the number of actors involved and the methods of sample taking and analysis. The rules on penalties of infringement to national provisions are also described.

Key results of the monitoring program (in 2007)

The results of the monitoring programs cover particularly the outcome of the inspections on product compliance as far as concerns VOC content and labelling. Non-compliance with regard to VOC-content in the different Member states is listed in Table 6 below:

Table 6: non-compliant products VOC-content

Member State	% non-compliant products 2007 limits
Belgium	No VOC content analyses in 2007 (planned 2008 – 2009)
France	No incidents of non-compliance
Germany	2 – 9 % non-compliant products
The Netherlands	4 % (6 % when including paints for vehicle refinishing)

The written monitoring program of the Netherlands provides insights on the methodology used for screening how the provisions of the Directive are followed.

Firstly, an inventory of the total paint market in the Netherlands was made through internet research and with information obtained from the sector. The inventory consists of the different products (assigned to the subcategories of the Directive) and the actors involved (manufacturers, distributors and wholesalers). Evaluation shows that approximately 80 to 85 % of the total market was covered by the inventory (5850 products).

The main objective of the second step was building up a representative sample of actors / products to control labels and VOC-content. Evaluation learns that the quantities of products in a subcategory are more or less proportional to the turnover related with each category. The quantities to be controlled per subcategory were determined in relation to the quantities per subcategory from the (market) inventory, with a minimum of 2 and a maximum of 9 per subcategory for checks of VOC-contents (3 and 32 for label checks), striving at 48 sample checks of VOC-content.

In total, 50 samples were further analysed in a laboratory with only 2 exceeding the 2007 VOC-limit from the Directive. In one of these cases, VOC limit is only surpassed with 15 g/l or 4%. In 90% of the samples the level of VOC stated on the label corresponds with the results of the tests. The report also lists the results of the laboratory tests with the actual VOC contents for the products tested within each subcategory.

Discussion

The evaluated monitoring programs learn that most of the products checked in 2008 were in line with the 2007 limits from directive 2004/44/EC. The rate of non-compliance ranges from 0% in France to a 9% estimation in Germany. Reporting from the Netherlands provides the most objective and transparent information. The report n the monitoring project is publicly available and contains VOC-contents of products per subcategory of the paints Directive. These (averaged) values could be used as an indication of the solvent content in paints products in 2007.[10]

3.5 Assessment and review of Directive 2004/42/EC: project coordinated by Ökopol GmbH

The report provides background information and amendment proposals for the Commission for the preparation of the future review of Directive 2004/42/EC. The current scope covers 12 categories of decorative paints and varnishes used in the building sector and 5 categories of vehicle refinishing products used for road vehicles.

The project assessed several options for further VOC reduction in line with the provisions of article 9 of Directive 2004/42/EC, e.g. the inclusion of products currently outside the scope of the directive or the introduction of stricter VOC limit values for products under the Directive. Additionally, the first period of implementation of the Directive has been evaluated.

Member States and stakeholders (paint producers and users) were consulted on implementation problems and on their proposals to improve the directive. Furthermore, the potential for an extension of the scope of the Directive was assessed via literature, internet research and information obtained from consultations of European and national industry associations, individual companies, research institutes and Member State authorities. VOC relevant data were compiled on products covered by the current scope and products potentially to be covered in future. Data were collected from stakeholders and literature research, comprising sales amounts and related VOC contents.

The key elements of potential relevance for this study are summarised in the table below. Note that the elements are proposals and viewpoints from the project team that performed the study and not necessarily the official viewpoint of the Commission. It can however demonstrate the direction that could be followed by the Commission.

Table 7: Options for review of 2004/42/EC

Option assessed or evaluations in the report	**Elements for assessing probability for revision?** • **Remarks from stakeholders** • **more information on the option**	**Relevance for this study**
Scoping of the Directive and stricter VOC limits		
Evaluation of current categories and VOC limits for decorative coatings	• Consultation of Member States and industry • Industry (e.g. CEPE and UNIEP): the 2010 ceilings represent practical limit of what is technically feasible without compromising quality and choice across	• Categories where stricter VOC limits could be possible • Reclassification of

[10] It is important to mention that the Netherlands have additional regulations for painting work indoor (arbo-wetgeving). Since 2004, the VOC-content of products for use indoor has been limited (to 60 g/l)

	Europe. • The study argues however that reduction options may be feasible in certain categories, partly within the ongoing revision process	certain categories
Option new VOC limit values for interior use of decorative paints in categories d), e) and f)	• CEPE: difficulties enforcing the proposed regulation (both professional users and consumers may still use the higher level VOC containing paints thus reducing expected benefits) + more products (dual use interior and exterior excluded) • One manufacturer estimated that only about 5 % of its current production volumes were currently compliant with the proposed limits • Compliant products are available indicating that there are no technical barriers to their production and performance	• Categories where stricter VOC limits could be possible • Reclassification of certain categories
Scoping and definitions		Not relevant
Extension of the scope with new product categories		
General consultation for scope extension	• VOC limits for various products in California (Problem: alternative definitions of VOC which makes it hard to compare) • Information collection on products selected for scope extension: IVAM, 2005 / EC, 2002 • Existing VOC-limits (non paints) in Member States: rare examples in e.g. the Netherlands, Sweden and Austria • Proposals from Member States (Belgium has proposed to include products for vintage (historic) vehicles, heavy duty (protective / anticorrosive) coatings, aerosols, cosmetics, cleaners and household products and other deco products in housing situations for metal, wood (furniture) etc	• Information on VOC-content of different products • Relative share of VOC emissions (key categories)
Protective coatings	• CEPE: take up protective coatings, level playing field (specialty applications) • Decrease in demand, application by specialists (xxx paint, difficult to apply thin layer), possibly longer drying time.	• Information on VOC-content
Floor covering adhesives	• In earlier studies, adhesives have been identified as a product group in which VOC reduction can be possible and feasible. Floor coverings (hard and soft) are forming a subgroup.	• Information on VOC-content (water-based, solvent-based) • Trends in use of

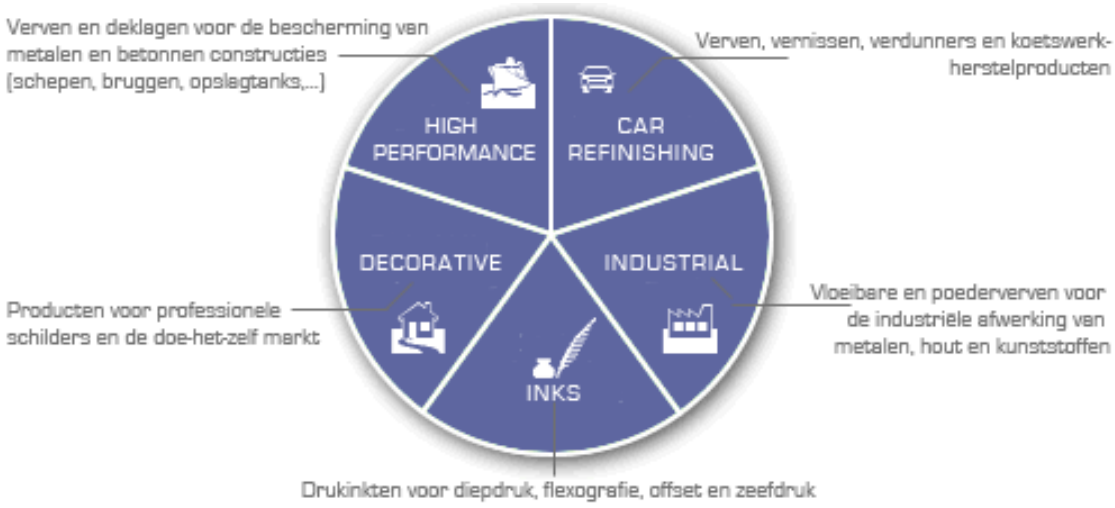
	• There are alternatives for adhesives, but not necessarily for all applications (substrates under tension, outdoor application, …) • Assessment has been made with a (low) VOC-limit of 5 g/kg, leaving only waterborne, solvent-free or 'not in kind' alternatives (mechanical fixation, double sided tape) as an option. • Existing regulation (5 g/kg) in the Netherlands for *indoor* (since 2000). No major problems have been identified. However, detailed guidance on which products to choose for which specific application appeared to be necessary.	solvent-based adhesives
Deodorants and antiperspirants	• In cosmetics the highest VOC reductions can be achieved by VOC reduction in hairsprays and deodorants • Ban on aerosol technique conflicts with user preferences and cultural habits. Large scale impact on the market as no alternatives are available • Compressed gas can be an emerging technique	• Information on VOC-content per "technique"
Hairsprays	• In cosmetics the highest VOC reductions can be achieved by VOC reduction in hairsprays and deodorants • Content below 90 % would reduce the performance • Compressed gas can be an emerging technique	• Information on VOC-content per "technique" • Market aerosol hairspray / pump hairspray (+/- 10%)
Glass and window cleaners	• These cleaners can be effective with VOC content below 5% or even 3% • A.I.S.E, International Association for soap, detergents and maintenance products: average VOC content existing outputs +/- 8%, limit below 3% is probably not technically feasible • (Large) part of the window cleaning products already contains less than 5% VOC	• Information on VOC-content
Aerosol type insecticides	• Consultation with federations did only lead to answer that these products should not be covered by the directive. • Products without VOC will loose its functional advantages • Products are already covered by the biocidal products Directive 98/8/EC. ANNEX 56 emission estimates	• Information on VOC-content

4 AVAILABILITY OF RELEVANT DATA FOR BCR

4.1 Paint

4.1.1 Sales data from IVP

IVP is an industry association, representing producers and importers of paints, varnish, printing inks en paint for artistic purposes en thus represents the Belgian paint industry in CEPE (European Council of the Paint, Printing Inks and Artists' Colours Industry). IVP represents about 70 companies with about 3.500 employees in total. The activities of IVP are divided in specific sectors, as shown in the picture below.



IVP collects sales data from its members on a yearly basis, differentiated in 13 categories. The sales data do not account for intercompany sales, which means that sales data will be representative for consumption data. Table 8 shows an overview of sales data for decorative paint in Belgium in 2007, as provided by IVP. Decorative paint is the paint used by private households and by professional painters (architectural applications). These data are assumed to be 85% of total sales of paints in Belgium. IVP sales data need therefore to be scaled up to 100% to estimate total sales in Belgium. A distinction is made between water based (WB) and solvent based (SB) paints. Similar sales data are available since 2003.

Table 8: Overview of sales data (85% market share) for decorative paints in Belgium in 2007 (IVP, 2010)

This Table is only available in the confidential Annex to this Main report.

4.1.2 Data on NMVOC content of paints by CEPE

CEPE is the European Council of producers and importers of paints, printing inks and artists' colours. CEPE represents the interest of approximately 1000 members in the European Union, Norway and Switzerland. Two sets of data are available through CEPE on the solvent contents of paint sold/used in Belgium:

- A database set up in view of the submission of information in the framework of the RAINS-programme, giving information on the solvent-content of 10 different paint types (referring to the Paints Directive), for each giving the distinction between water and solvent based paint, for the years 1990, 2000, 2010 and a view beyond 2010

- A spreadsheet, giving information on solvent contents and sales data End of 2008, CEPE submitted paint volumes and VOC-content data to the EU authorities. The estimations made were based on estimations of sales data and VOC-contents per specific paint category as indicated in the Paints Directive (and thus different from the IVP categories).

4.1.2.1 Dataset in framework of RAINS reporting

An overview of shares of paints of different segments in total sales data for decorative paints in Belgium is shown in Table 9. The NMVOC contents are shown in Table 10 (CEPE, personal communication, 2010).

Table 9: Overview of shares of paints of different segments in total sales data for decorative paints in Belgium (CEPE) (CEPE, personal communication, 2010)

This Table is only available in the confidential Annex to this Main report.

Table 10: Overview of NMVOC-contents of paints of different segments in total sales data for decorative paints in Belgium (CEPE) (CEPE, personal communication, 2010)

This Table is only available in the confidential Annex to this Main report.

Figure 5: Trend in shares in total sales and solvent contents of waterbased paints in Belgium (CEPE, personal communication)

This Figure is only available in the confidential Annex to this Main report.

Figure 6: Trend in shares in total sales and solvent contents of solvent based paints in Belgium (CEPE, personal communication)

This Figure is only available in the confidential Annex to this Main report.

Based on abovementioned data, ARCADIS calculated weighted averaged NMVOC-contents for WB and SB paints as a whole for different years based on following formula (for Water-Based paint)[11]:

$$\text{NMVOC}-\text{content (in g/L paint)}_{WB} = \frac{\sum_{\text{segment}_{WB}} \left(\text{Share in total sales}_{WB} \text{ x NMVOC}-\text{content}_{WB}\right)}{\sum_{\text{segment}_{WB}} \text{Share in total sales}_{WB}}$$

The result is given in Table 11.

[11] The same formula can be used for Solvent-Based paint

Table 11: Weighted averaged NMVOC-contents (in g NMVOC per liter paint) of Water- and Solventbased paints used in Belgium (ARCADIS calculation based on CEPE information)

Categories	1990	2000	2010	Beyond 2010
Waterbased paint	76	57	48	45
Solventbased paint	560	510	398	415

The solvent content of WB paints decreased from 76 g/l in 1990 tot 48 g/l in 2010. The solvent content of SB paints decreased from 560 g/l in 1990 to 398 g/l in 2010. Beyond 2010 a slight increase of the overall solvent content of SB paints is assumed, due to decrease in usage of those solventbased paints containing lower NMVOCs.

4.1.2.2 CEPE reporting to EU authorities 2003-2006

Table 12 gives an overview of the sales data and VOC contents for different paint categories for Belgium for the years 2003 and 2006, as reported by CEPE to the EU authorities in 2008.

Table 12: Overview of sales data and VOC contents for different paint categories in Belgium for 2003 and 2006 (CEPE, 2008)

This Table is only available in the confidential Annex to this Main report.

4.2 Other household products

4.2.1 Sales data and NMVOC contents from DETIC

This chapter is only available in the confidential Annex to this Main report.

4.2.2 Consumption data through GfK Panel Services Belgium

GfK advises almost all manufacturers and retailers in the Fast Moving Consumer Goods market. Its recommendations are based on information collected about the purchasing and consumer behaviour of households in particular. This is done by enlisting with the help of a continuous panel of households, ConsumerScan and sometimes that of the ConsumerJury panel, especially if information other than purchasing behaviour is required. Especially the ConsumerScan, possibly offers relevant information for this study. The GfK ConsumerScan panel has been set up to conduct continuous surveys. The focus is on the market sector of Fast Moving Consumer Goods, fresh products and items for personal care. In other words, all the articles sold by supermarkets, chemists and speciality shops such as butchers, bakers and greengrocers. The ConsumerScan panel consists of a representative sample of 4,000 households in Belgium, who record their daily purchases electronically by means of the EAN/barcode. Other data, not necessarily related to purchases, can also be collected from the panel. This not only enables trends to be reported down to the level of details, but explanations can also be given for behaviour. These insights lead to knowledge that enables marketing and sales processes to be made more efficient.

In view of this study, the Brussels Capital, The Walloon and Flemish Region and the Federal Public Service Health, Food Chain Safety and Environment, sponsored the purchase of GfK-market data. Data were purchased for:

- Cosmetics and toiletries
- Cleaning products
- Deodorants
- Hair spray
- Hair modelling products
- Face care
- Spot removers
- Hand soap
- Hand & body care
- Air fresheners
- Glass/window cleaners

Data were provided in Volumes (1000 Liter) and for the year 2008.

4.2.3 Consumption data from the household budget survey

The Household Budget Survey produces annual data on the expenditure structure and incomes of the average household at the national and the regional level. The Household Budget Survey produces information about the consumption expenditure of households for consumables, investments goods, energy, services, savings and debt. The survey gives also information about characteristics of the household as activity, age, education level, etc. The possession of durable consumer goods, living conditions, rental value of the occupied accommodation, charges paid in relation to housing, periodic payments,…are collected data of households by interviews or diaries. In 2007, 657 households were surveyed. The response rate was 77,6 %. Table 13 gives an overview of the total expenses of households in 2007 in Belgium and the different regions for products used for maintenance of the house, pharmaceuticals and cosmetics.

Table 13: Excerpt from the Household Budget Survey in 2007 in Belgium (House maintenance)

Code	Category	Average expenses per household in 2007 (in EURO)			
		Belgium	Brussels Capital Region	Flemish region	Walloon region
0	**TOTAL CONSUMPTION**	**32,577**	**29,189**	**34,069**	**31,130**
46	**HOUSE MAINTENANCE**	**679**	**541**	**723**	**648**
4611	***Cleaning and maintenance products***	***193***	***153***	***191***	***209***
461101	Detergents, soaps and related articles	102	82	107	101
461102	Maintenance products for shoes	1	1	2	1
461103	Chemical products for gardening	11	2	11	15
461104	Chemical products for housekeeping	48	47	44	54
461105	Other maintenance products	30	21	27	38
4631	***Washing and painting***	***28***	***44***	***31***	***18***
463101	Washing of textile	10	9	15	2
463102	Cleaning of linen, curtains,…	5	6	3	7
463103	Products for laundry (washing, ironing)	8	8	9	5
5	**HEALTH**	**1,532**	**1,368**	**1,570**	**1,520**
51	**FARMACEUTICAL PRODUCTS**	**483**	**414**	**453**	**558**
5101	***Medicine***	***319***	***298***	***303***	***351***
510101	Medicine, disinfectant, vitamines	318	298	303	351
510102	Magistral preparation	0	n.m.	n.m.	n.m.
510203	Farmaceutical articles	12	10	13	12
5103	***Not specified purchases at the pharmacist***	***150***	***107***	***133***	***193***
510301	Not specified purchases at the pharmacist	150	107	133	193
8	**OTHER GOODS AND SERVICES**	**6,401**	**5,411**	**6,897**	**5,875**
81	**PERSONAL HYGIENE**	**646**	**647**	**681**	**586**
8121	***Products for personal hygiene***	***243***	***299***	***231***	***247***
812101	Soap, shampoo, toothpaste, shaving creme	64	66	65	62
812102	Perfume, toiletwater, aftershave	49	71	38	60
812103	Other products (bathsalt, hairspray, ...)	131	162	128	125

Information on the survey can be found on following website:

http://statbel.fgov.be/nl/statistieken/gegevensinzameling/enquetes/huishoudbudget/index.jsp

The results of this survey are not directly applicable for this study, since expenditures in EURO still need to be translated to consumption in kilograms or liters. On the other hand, the data can be used to check whether the consumption pattern in The Brussels Capital Region is comparable with the consumption pattern in Belgium and/or other regions, since most of the statistics will include Belgium as a whole. The general trend is that, except for personal care products, the expenditure per household in Brussels is somewhat lower than in the other regions and in Belgium as a whole.

4.2.4 Other explored links and publications

4.2.4.1 OIVO/CRIOC

OIVO is responsible for putting together the “household basket”. In this study the weekly average expenditures of households are estimated based on the average income, the average number of family members, the average savings, the total yearly expenditures. The aggregation level in which the expenditures are presented is to high to be useful for this study.

4.2.4.2 FEDIS

Fedis represents the small, medium and large stores, chain stores, supermarkets and hypermarkets in Belgium. They however do not collect sales statistics and can thus not provide information on that.

4.2.4.3 Federal Public Service: Health, food chain safety and environment

Information collected in the framework of the Program for Reduction of Pesticides and Biocides is confidential and not available for this study.

4.2.4.4 IVAM (2005)

The IVAM (2005) report describes the emissions of VOCs from cosmetics and cleaning agents in The Netherlands. These products were selected by the Dutch Ministry of Housing, Spatial Planning and the Environment (VROM) in view of the review article, included in The Paint Directive (2004/42/EC), referring to the inclusion of other product groups. Statistics on product use were to a large extent provided by Dutch and Belgian trade organizations. Total VOC emissions from cosmetics in the Netherlands were estimated at 9.9 kton, with hair sprays and deodorants/antiperspirants (aerosols) as main contributors with emissions of 3.5 and 3 kton, respectively. Total VOC emissions from cleaning agents in the Netherlands were estimated at 10.3 kton, with air freshener and car window cleaners as main contributors with 1.9 kton and 3 kton, respectively. Emissions were mainly due to the use of solvents and propellants.

The IVAM study contains consumption data, VOC contents and emission factors for different product groups.

Table 14 and Table 15 give an idea of the data availability through the IVAM study.

Table 14: VOC use and emission (kton/year) from cosmetics based on market survey data made available by NCV (IVAM, 2005)[12]

Product category	Product use	Maximum VOC content (%)	VOC use*	Emission factor	VOC emission	VOC emission including professio-nal products#
Shampoo/conditioner	18,16					
Shampoo	14,34	1	0,16	0,05	0,01	0,01
Conditioner	3,81	2	0,08	0,05	0,00	0,00
Hair styling products	12,69					
Hair spray (total)	3,27					
Hair spray (aerosol)$	2,98	95	3,14	1	3,14	3,45
Hair spray (pump)	0,29	35	0,11	1	0,11	0,13
Foam	1,66	11	0,20	1	0,20	0,22
Modelling product	6,76	13	0,94	0,85	0,80	0,88
Hair dye	1,07					
Permanent dye cream	0,43	0	0,00	0,85	0,00	0,00
Permanent dye liquid	0,33	10	0,04	0,85	0,00	0,03
Semi permanent cream	0,07	0	0,00	0,85	0,00	0,00
Semi permanent liquid	0,07	10	0,01	0,85	0,00	0,01
Direct dye	0,10	0	0,00	0,85	0,00	0,00
Dye mousse	0,05	7	0,004	0,85	0,00	0,00
Dye strenghtener	0,01	40	0,005	0,85	0,00	0,00
Soap, bath and shower product	26,85	5	1,49	0,05	0,07	0,07
Deodorant						
Aerosol$	3,04	88	2,96	1	2,96	2,96
Roll-on	1,56	31	0,54	0,85	0,46	0,46
Hand & body care	5,27	5	0,29	0,85	0,25	0,27
Hand care	1,01					
Body care	4,26					
Face care	2,87	15	0,48	0,85	0,41	0,45
Cleansers	1,47					
Moisturizers	1,18					
Sun cosmetics	1,06	10	0,12	0,85	0,10	0,10
Tooth paste	4,82	3	0,16	0,05	0,01	0,01
Shaving product	2,02	15	0,34	0,50	0,17	0,19
Aftershave	0,31	60	0,21	0,85	0,18	0,18
Perfume	0,49	80	0,44	0,85	0,37	0,37
Nail polish	0,18	80	0,14	0,85	0,12	0,13
Nail polish remover						
TOTAL						9,92

* corrected for 90 % coverage of market survey (except nail polish for which an estimate was made in consultation with the NCV)

addition of professional products is assumed to be 10 % for products used in hairdressing salons, nail salons and beauty parlours (percentage corroborated by the NCV (Lagendijk & Pfeifer, pers.comm.))

$ for sprays, an average density of 0,75 kg/L was assumed

[12] Since this is an excerpt from a Dutch study, decimals are indicated with ‘,’

Table 15: VOC use and emission (kton/year) from cleaning products, (partly) based on monitoring data from 2003 and 2004 made available by the NVZ (IVAM, 2005)[13]

Product category	Product use	VOC content (%)	VOC use by consu-mers	Profes-sional VOC use	Total VOC use	Emis-sion factor	VOC emis-sion#	Reference$
Methylated spirit			1,97	0,00	1,97	0,38	0,75	
Benzine/stain remover			0,25	0,11	0,36	1	0,36	
Glass/window cleaner			0,18	0,15	0,33	1	0,33	
Hand cleaner			0,08	0,42	0,50	0,5/0,83*	0,38	
Air freshener			1,65	0,21	1,87	1	1,87	
Carpet cleaner			0,03	0,02	0,05	1	0,05	
Detergent (powder)	37	1			0,41	0,05	0,02	
Detergent (liquid)	39	9			3,90	0,05	0,20	
Other textile care product	23	3			0,77	0,05	0,04	
Machine diswash	9	1			0,10	0,05	0,01	
Manual dishwash	17	7			1,32	0,05	0,07	
Machine dishwash auxiliary product	8,6	1			0,10	0,05	0,00	
Bleach product	21,4	1			0,23	0,45	0,11	
Scourer	3,8	4			0,17	0,05	0,01	
Universal cleaner	19	10			2,11	0,10	0,21	
Façade cleaner and graffiti remover					0,11	0,85	0,09	Tukker & Simons (1999)
Car wax					0,14	0,85	0,12	PRODCOM
Car plastic care product							0,22	Infomil (2002)
Car window cleaner							3,00	Infomil (2002), CREM (2000)
Car de-icer							0,30	Infomil (2002)
Bathroom and kitchen mousse							0,02	FEA (2004)
Oven cleaner							0,01	FEA (2004)
Disinfectant							1,27	Infomil (2002), CREM (2000)
Metal polish					0,42	0,85	0,36	PROD-COM
Leather and shoe maintenance product							0,36	Infomil (2002)
Furniture maintenance product							0,15	Infomil (2002)
TOTAL							**10,31**	

* different EF's for consumer and professional products are assumed because products are different (and applied/used in different ways)

consumer and professional products

$ where no reference is stated data are from NVZ; VOC contents based on: Lever Fabergé (2002); NVZ (2004a); Staats & Van Raalte (2002)

[13] Since this is an excerpt from a Dutch study, decimals are indicated with ','

PART 2 SETTING UP AN EMISSION INVENTORY FOR THE BRUSSEL CAPITAL REGION

5 ASSESSMENT OF DESCRIBED METHODS AND DATA

5.1 General assessment

This chapter includes an assessment of all methods described in chapter 1 and the available data listed in chapter 4 and shows a critical view on the pro's and cons of the different methods to be used.

The aim of this overall assessment is to:

- Give a compilation of data needs for each possible method
- To indicate possible sources to complete the formula
- To indicate the representativity of the data for BCR and the overall quality of the data
- To indicate whether additional processing of the data is needed before they can be used for the BCR

For quality assessment, two parameters are assessed:

- Are the data representative for the BCR:
  - A information specific for BCR
  - B information for Belgium (including BCR)
  - C information representative for Belgium (including BCR)
  - D information is less representative for Belgium (including BCR)
- What is the quality of the data itself:
  - A Very high quality data /based on intensive survey / complete
  - B High quality data, based on representative sample
  - C Medium quality data, extrapolated based on limited data
  - D Low quality data (rough estimation or old)

The result for "paint use" and "use of other household products" are given in the following tables.

Table 16: Overview of the data needs to estimate NMVOC emissions through domestic solvent use

POSSIBLE METHOD	DATA NEEDS	AVAILABILITY	REPR	QUAL	REMARK
Amount of substance consumed x NMVOC-content x Share emitted to air					
	List of products	DETIC (detergents, cosmetics and adhesives)	B	B	
		BIM study on cleaning products (not yet available)	A	C	not yet available
		GfK (available at a cost)	A	B	available for some products - complements DETIC
		Bipro (2002)	C	C	
		Compilation of international emission inventories (NL, Norway, France, Sweden, Denmark, Finland, Iceland)	C	B	
		Ökopol (2009)	C	A	Based on IVAM (2005)
		Household Budget Survey	B	B	
		IVAM (2005)	B	A	
	Amount of product consumed	DETIC (detergents, cosmetics and adhesives)	B	B	To consumption per inhabitant for BCR
		BIM study on cleaning products (not yet available)	A	?	not yet available
		GfK (available at a cost)	A	B	available for some products - complements DETIC
		Household Budget Survey	B	D	From EUR --> liter/kg, allocation to BCR
		Ökopol (2009)	C	C	To consumption per inhabitant for BCR
		IVAM (2005)	B	?	to be reviewed
	NMVOC-content	BIM study on cleaning products (not yet available)	A	?	not yet available
		Bipro (2002)	C	B	
		Ökopol (2009)	B	B	recent updates for cosmetics
		IVAM (2005)	B	B	
	Share emitted to air	Ökopol (2009)	B	B	Based on IVAM (2005), some updates
		IVAM (2005)	B	B	default value per type of product
		DETIC (detergents, cosmetics and adhesives)	B	C	unknown how these were derived
NMVOC-emission per inhabitant x number of inhabitants	List of products	see above			
	Emission per inhabitant	NL 1994	C	D	old data, probably broader than households
		California 1997	D	D	old data, probably broader than households
		Belgium (VITO/Econotec)	B	D	old data, probably broader than households
		NL emission inventory (1990-2007)	C	B	
		CITEPA (2009)	C	?	unknown how these were derived
	Number of inhabitants	NIS	A	A	

Table 17: Overview of the data needs to estimate NMVOC emissions through use of decorative paint in households

POSSIBLE METHOD	DATA NEEDS	AVAILABILITY	REPR	QUAL	REMARKS
Amount of paint consumed x NMVOC-content x Share emitted to air					
	List of categories	IVP	B	A	
		CEPE	B	A	
		Legislation	B	C	
	Amount of paint consumed	IVP (based on sales, import, export)	B	B	Allocation of total to BCR
	NMVOC-content	CEPE (country specific survey)	B	A	Validation of future scenario needed
		CITEPA	C	?	
	Allocation to private/professional use	RAINS, Norway	B	B	Possibly based on product types
NMVOC-emission per inhabitant x number of inhabitants	List of products	see above			
	Emission per inhabitant	Flemish region	C	B	Allocation to BCR
		NL emission inventory (1990-2007)	C	D	
		CITEPA (2009)	C	D	
	Number of inhabitants	NIS	A	A	
	Allocation to private/professional use	RAINS, Norway	B	B	Possibly based on product types

5.2 Selection of most important households products

A stepwise approach has been followed in order to select the products that may contribute significantly to emissions of NMVOC. Through extensive literature research, following actions have been performed:

- Draft a **comprehensive list of products** (used in households) leading to NMVOC-emissions
- Match product(s) categories with **available information sources**
- Identify the **product(s) categories** with the **largest** potential **NMVOC-emissions**

5.2.1 Products used in households with NMVOC-emissions

Products mentioned in the various literature sources have been listed and grouped in main categories and smaller subcategories. Most information sources use the same main categories: cosmetics, cleaning products, car (care) products, leather and furniture care, Do-It-Yourself / building, pesticides and office products.

The list has been drawn up in spreadsheet format and totals approximately 120 lines, including both individual products and more aggregated categories. The list also contains products with very low NMVOC-contents and products where probably no quantitative information is available.

5.2.2 Information availability on the identified products

Available literature has been screened for quantitative elements that could contribute to the calculation of total emissions in the Brussels Capital Region. In this phase of the study, all relevant data has been integrated, both older and more up to date information. Useful information can be either publicly available literature or statistics from third parties e.g. sector associations, national statistics institutes.

The existing list of products has been complemented with this information in a spreadsheet format. Due to confidentiality reasons, this spreadsheet is not added to the document yet.

5.2.3 Selection of the products with the largest emissions

It can generally be assumed that the bulk of the NMVOC emissions are due to the use of a relatively small number of consumer products. The EMEP / Corinair guidebook suggests that it is good practice to give priority to these products, so-called *key categories*, when setting up an emission inventory. An assessment on key categories has been executed combining various information sources from the Netherlands. A more limited list of products and their relative share in total NMVOC-emissions is shown in the table below. The table can be used as a starting point for an emission inventory for the Brussels Capital Region, with possibilities for modifications when deemed appropriate. Smaller sources of VOC-emissions can possibly be grouped or included in other product (group)s.

Table 18: Products with the largest NMVOC-emissions (calculations by Arcadis based on various sources for the Netherlands)

PRODUCT CATEGORIES	RELATIVE SHARE	REMARKS
Deodorants and antiperspirants	+/- 25%	The two product groups with the largest estimated NMVOC-emissions account for around 50% of the emissions from (domestic) use of products. Further subdivision into individual products can be useful as the aerosol version of these products will be the largest source of NMVOC.
Hair modelling products	+/- 25%	
Windscreen washing fluid	16.6%	The relative share is possibly overestimated as it is not yet certain if this figure is based on household consumption only.
Air freshener	5.8%	
Rubbing alcohol / (Disinfectants?)	3.9%	The scope and relevance of this product group will be further investigated. According to Ökopol (2009), disinfectants are almost exclusively for professional use.
Spiritus / alcohol	2.3%	The scope and relevance of this product group will be further investigated
Glues and adhesives	2.0%	VOC-emissions are generally originating from solvent-based adhesives.
Shoe shine and leather protection	1.9%	
Face care	1.9%	
De-icer	1.7%	
Perfumes	1.5%	
Pesticides / Biocides	1.3%	The scope and relevance of this product group (for BCR) will be further investigated
Plastic care products	1.2%	
Spot remover	1.1%	
Hand cleaners	1.1%	
Hand & Body care	1.1%	
Glass / window cleaner	1.0%	
Shaving lather	0.8%	
Furniture care	0.8%	
After shave	0.8%	
Car waxes and polishes	0.7%	
General purpose cleaners	0.7%	
(Special) liquid detergents	0.6%	
Nail polish	0.6%	
Sun cosmetics	0.4%	
Bleach product	0.3%	
Soap, bath and shower product	0.3%	
Office products	0.2%	
Dishwash agents (manual)	0.2%	
Hair dye - various products	0.2%	
Carpet (and upholstery) cleaner	0.2%	
Fabric softener	0.1%	
Dishwashing machine agents	0.0%	
Shampoo/conditioner - Shampoo	0.0%	
Toothpaste	0.0%	
Kitchen cleaners	0.0%	
Shampoo/conditioner - Conditioner	0.0%	

6 DEVELOPMENT METHOD FOR BCR 1990-2008

6.1 Use of paint

For paint use we start from the following formula:

Emission = A_{DP} x $\{(F_S \times SC_S) + (F_W \times SC_W)\}$ x $\{(F_{CON} \times ALL_{BCR,CON}) + (F_{PROF} \times ALL_{BCR,PROF})\}$ where:

- Emission = Emission of NMVOC in kg
- A_{DP} = Total sales of Decorative Paint in Belgium [kg]
- F_S, F_W = Fraction of solvent-based and water-based paint in total paint sold [-]
- $F_{CON/PROF}$ = Fraction of Decorative Paint in Belgium used by consumers/professionals [-]
- SC_S, SC_W = Solvent Content of solvent-based and water-based paint [kg solvent/kg paint]
- $ALL_{BCR,CON/PROF}$ = Allocation parameter from Belgium to Brussels Capital Region for consumers/professionals

6.1.1 Sales data (A_{DP}) and fraction solvent/water based (F_S, F_W)

Total sales of decorative paints in Belgium can be estimated based on sales data provided yearly by IVP (cf. chapter 4.1.1). Data are provided in liter. These data are assumed to be 85% of total sales of paints in Belgium. IVP sales data need therefore to be scaled up to 100%.

Since sales data are provided separately for water based and solvent based paints, the fraction solvent-based and water-based can easily be calculated.

6.1.2 Solvent content (SC_S, SC_W)

As indicated in chapter 4.1.2 of this report, two sets of data are available through CEPE on the solvent contents of paint sold/used in Belgium:

- A database set up in view of the submission of information in the framework of the RAINS-programme, giving information on the solvent-content of 10 different paint types (referring to the Paints Directive), for each giving the distinction between water and solvent based paint, for the years 1990, 2000, 2010 and a view beyond 2010
- A spreadsheet, giving information on solvent contents and sales data End of 2008, CEPE submitted paint volumes and VOC-content data to the EU authorities. The estimations made were based on estimations of sales data and VOC-contents per specific paint category as indicated in the Paints Directive (and thus different from the IVP categories).

Both data sources are analysed and processed in view of selecting the most relevant, appropriate solvent contents in our model. In Figure 7 following information is shown for water based on solvent based paints separately:

- The weighted average solvent content for 1990, 2000, 2010, beyond 2010
- The evolution in solvent content between 2000 and 2010 assuming a linear trend
- The weighted average solvent content for 2003 and 2006 as submitted to the EU authorities by CEPE in 2008
- The evolution in solvent content between 2003 and 2010 assuming a linear trend

All solvent contents are reported in g/L.

Figure 7: Overview of data on the solvent content of paint sold in Belgium (CEPE, 2010)

Table 19: Overview of the assumed solvent contents in paint for the proposed method

This Figure, the concluding text and Figure 19 are only available in the confidential Annex to this Main report.

6.1.3 Fraction of decorative paint used by consumers or professionals ($F_{CON,PROF}$)

Decorative paint sales data include paint for domestic and architectural use. In Flanders, the split of emissions to "domestic" and "architectural use" is based on estimations in RAINS[14], resulting in 34,3% and 33.8% for domestic use in 2007 and 2008 respectively. Since no additional useful information was found to allocate total decorative paint sales to domestic and architectural use, an attempt was made to try to validate the RAINS assumptions:

- According to IVP-data, about 39 million liter paint was sold in Belgium in 2007
- Based on a websurvey, we can assume an average price of 20€ per liter paint (based on the prices found for 91 different paints of about 8 different brands (ref: www.brico.be)
- The combination of the 39 million liter with an average price of 20€ results in a total consumption of decorative paint of 780 million EURO
- The Household Budget Survey shows that the expenditure of households for paints is 60, 75, 67 EURO respectively in the Brussels Capital Region, the Flemish Region and the Walloon Region, in combination with the amount of households this bring us to a total expenditure of about 320 million EURO for paint
- Based on these data, we could estimate that domestic consumption is about 41% of the total sales of decorative paint in Belgium

In the NMVOC emission inventory for Norway (Holmengen & Kittilsen, 2009) emissions from decorative paint applications are reported separately for 'construction' and 'private households and public use' (see Figure 4). Based on these data, we calculated for 2007 a share of 37,6% for 'private households and public use'.

Although this is somewhat higher than the assumptions made in RAINS, we prefer to use the RAINS data, since these are used on a European level to calculate cost-curves and are used in many international publications. Moreover, the Flemish and Walloon Region base their estimations on the RAINS allocation data and using them also for the Brussels Capital Region would improve consistency. Our validation exercise can be used to identify the uncertainty level of the results. An overview of the assumed values for the F_{CON} parameter is given in Table 20.

[14] RAINS is the Regional Air Pollution Information and Simulation model, developed by IIASA

Table 20: Overview of the assumed values for the Fraction of total decorative paints, used by consumers (F_{CON})

	Fraction of decorative paint used by consumers (F_{CON})								
	1990	1995	2000	2005	2006	2007	2008	2009	2010
F_{CON}	0.408	0.393	0.375	0.353	0.348	0.343	0.338	0.333	0.327

6.1.4 Allocation parameter from Belgium to the BCR ($ALL_{BCR, CON/PROF}$)

In Flanders, The Walloon Region and The Netherlands, the regional allocation of VOC-emissions from use of decorative paint (domestic+professional), starting from national sales data, is based on the population density. The allocation factors based on the number of inhabitants are shown in Table 21.

Table 21: Allocation parameter for the BCR calculated based on the number of inhabitants

Parameter	Belgium	Brussels Capital Region	Flemish Region	Walloon Region
Number of inhabitants (January 1, 2008)*	10655423	1044144	6153716	3457563
Share of Regions in Belgium (%)	100%	9.8%	57.8%	32.4%

(*) Federaal Planbureau; FOD Economie - Algemene Directie Statistiek en Economische Informatie

The choice of population density can be accepted in view of the assumption that in general, a household/family has an average amount of family members, each household in Belgium lives in a house with an average volume and with an average amount of furniture (internal/external) and thus will use an average amount of paint. Population density will thus give a rough indication of the allocation parameter.

However, intuition leads us to the idea that on the one hand there are maybe more apartments in Brussels and on the other hand there are more office buildings than average in Belgium which could influence those allocation parameters. In the following sections, more appropriate allocation parameters are therefore derived from more specific statistics.

6.1.4.1 $ALL_{BCR,CON}$

In chapter 4.2.2 a description is given of the Household Budget Survey. This survey also contains information on the expenses of households for paint used for internal and external applications. The relevant excerpt is given in Table 22.

Table 22: Excerpt from the Household Budget Survey in 2007 in Belgium (Paint for internal and external applications)

Code	Category	Average expenses per household in 2007 in EURO			
		Belgium	Brussels Capital Region	Flemish Region	Walloon Region
0	**TOTAL CONSUMPTION**	**32,577**	**29,189**	**34,069**	**31,130**
3	**RESIDENCE OR SECOND HOME**	**7,949**	**8,434**	**8,003**	**7,697**
31	**BRUTO RENT**	**6,177**	**6,855**	**6,288**	**5,761**
3113	Common maintenance costs	351	241	370	354
311301	Paint for internal and external applications	71	60	75	67

The combination of the average expenses for paint per household and the total number of households in 2007 in the different Regions in Belgium is shown in Table 23.

Table 23: Calculation of the share of expenses for domestic use of paint in the BCR in total expenses in Belgium for 2007

Parameter	Belgium	Brussels Capital Region	Flemish Region	Walloon Region
Number of households	4523391	500249	2550088	1473054
Share of households in total in Belgium (in %)	100.0	11.1	56.4	32.6
Expenses for Paint for internal and external applications per household (in EURO)	71	60	75	67
Total expenses for paint (in EURO)	319966158	30014940	191256600	98694618
Share of paint expenses in total in Belgium (in %)	100.0	9.4	59.8	30.8

At the time of the writing of this report, total expenses for paint are only available from the household budget survey of 2005, 2006 and 2007. For the other years the parameter $ALL_{BCR,CON}$ is therefore assumed to be the average of the allocation parameters, calculated for 2005, 2006 and 2007, resulting in 7.3%.

Table 24: Overview of the assumed values for allocation parameter from Belgium to The Brussels Capital Region ($ALL_{BCR,CON}$)

	Allocation parameter from Belgium to the BCR (ALL_{BCR})					
	1990	1995	2000	2005	2006	2007
ALL_{BCR}	0.073	0.073	0.073	0.084	0.091	0.094

6.1.4.2 $ALL_{BCR,PROF}$

Professional painters work for private households as well as companies (industrial buildings, office buildings). Therefore, the number and size of buildings in the BCR compared to Belgium could give us an idea of the paint use by professional painters in the BCR.

Table 25: Overview of the number, average size and total volume (m^3) of residential and non-residential buildings in Belgium and The Brussels Capital Region ($ALL_{BCR,PROF}$) in 2007

	Non-Residential Buildings		Residential Buildings		TOTAL	Share
	Number	Volume (m^3)	Number	Volume (m^3)	VOLUME	
BCR	35125	23697	543172	489	1097968233	10.9%
Flanders	423212	9890	2868361	605	5920925085	58.6%
Walloon	331205	6469	1538956	608	3078250393	30.5%
Belgium	789542		4950489		10097143711	100%

Based on Table 25, an allocation parameter from Belgium to the Brussels Capital Region for 2007 of 10.9% is used for professional use of paint. For other years this parameter is calculated with the same formula.

6.2 Household products

NMVOC-emissions from household products have been primarily calculated based on real consumption data, following the formula:

$Emission_{SH} = \{A_{SH} \times SC_{SH} \times EF_{SH} \times ALL_{SH}\}$where:

- $Emission_{SH}$ = Emission of NMVOC from the use of a solvent containing product (or category) SH in kg
- A_{SH} = Total consumption for BCR/Belgium of the product SH used in households [kg]
- SC_{SH} = Solvent Content of the product(category) [g/kg]
- EF_{SH} = Share of the solvent emitted to air [-]
- ALL_{SH} = Allocation parameter from Belgium to BCR [-]

We have focused on information that can possibly be available on a continuous basis to facilitate future inventory building. Emissions from nearly all selected products have been calculated based on specific data for Belgium or the Brussels Capital Region if a recent and reliable figure was available. Section 6.2.1 comments on activity data and the product information that has been assembled for the study and describes how the activity data were selected. The section also provides an evaluation of the selected figures (by using alternative sources). Then we discuss the information gathering process on specific products (contents, density). How the different parameters are completed, is explained in the following sections.

6.2.1 Consumption data for different solvent containing products (A_{SH})

As NMVOC emitting products are mainly cleaning products and cosmetics, an important information source are the detailed sales statistics from DETIC, the Belgian-Luxemburg association of producers and distributors of these products. Key advantages of these data are their continuous character (regular updates) and the availability at national level for Belgium. As already indicated, at explicit request of DETIC and its members, their detailed figures can't be shown for reasons of confidentiality.

For a number of key product groups, the order of magnitude has been cross-checked with market data from alternative sources. One important source of information is GfK, market analysts for household products (see section 4.2.2). Their figures are available for the three regions (Flanders, Brussels Capital Region and the Walloon region) and for the same year as DETIC-statistics 2008. For each product group, the most important checks are described.

For some products, it is relevant to know the individual usage figures instead of the figure for the whole group. Important examples are e.g. deodorants, hair styling products or air fresheners. NMVOC-emissions (per unit, per weight) from hairsprays (aerosol) are higher than for foams or gels. The same applies for deodorant sprays compared to sticks or roll-on deodorants. For the important product groups or whenever necessary (e.g. when an NMVOC-emission factor was only known for a specific product), available statistics were further split-up to individual products. These subdivisions were done using different methods:

- Market information from other statistics. For some products, GfK-data was used to further split-up the statistics provided by DETIC. This was possible for important categories e.g. hair modelling products, spot removers,…
- Market information from literature sources. CRIOC for all purpose cleaners and insecticides and plant protection. Ökopol (2009) for deodorants.

- Own market study. For some product groups, no detailed public information was found. The figures have been further subdivided based on an own analysis of shelf space in supermarkets. Market volumes in pieces were further split-up based on the relative share of the shelf they take in a large supermarket. This method is only an assumption and does not take into account rotation speed of the products but it does provide a rough indication and order of magnitude and is the only available. The model clearly shows how the assumptions were built up and allows future updates whenever additional or more correct information should be available. Categories where other information for market splits was totally lacking: air fresheners,…

The most important estimates are described per product group.

6.2.1.1 Cosmetics and personal care

Product group as a whole

GfK-market data are available for various product (groups) within cosmetics. As this is no publicly available information, only those products with the largest NMVOC-contribution were selected: deodorants and antiperspirants, hair modeling products, hand and body care, face care and hand soap. The latter product group was mainly requested if any information would be found on hand cleaning products including disinfectants.[15] Information at that level is however not identified during the project.

For **deodorants and antiperspirants**, the figures of both DETIC and GfK are only available at aggregate level. DETIC describes the market in units while GfK data is expressed in volume or liter. The figures were compared using product information (contents, density and market split to individual products) gathered from various sources. This process is described in more detail in the next paragraphs "individual products within the group". DETIC only gives statistics for Belgium. Calculated market figures (tonnage) for this product category are very similar for both sources and the discrepancy is only around 5%.

The figures for **hair styling products** are showing larger variations. GfK data is substantially lower than the figures from DETIC. Comparing both figures with usage data from the Netherlands (e.g. kg per inhabitant), the result suggests that GfK-statistics might be underestimated or that the definition of the product category differs between both. The calculated DETIC-figure (tonnage) is more comparable with the data from the Netherlands and is only lower for "fixed modeling" products like gel and wax. The advantage of the GfK-statistics is that the figure is further subdivided between hair sprays (largest NMVOC-source) and hair modeling products (gel, wax, foam). The market split (in weight) between these larger groups tends to correspond with the situation for Europe in Ökopol (2009). Hair sprays account for 45% of the market while in Europe this share is limited to 40%. This information is useful to allocate market data to individual products with different VOC-contents.

Hand and body care and **face care products** are smaller contributors to NMVOC-emissions. DETIC-figures appear to be reasonably higher than GfK-statistics. It is however found that the product definitions for the GfK-categories are more narrow and do not include all VOC-emitting products. Hand and body care in the GfK-figure e.g. does not include baby products, massage oils while DETIC most likely covers all these products. As these product groups only have a limited impact on the total VOC-emissions, the figures from DETIC are used. These DETIC-figures will most likely equally be available for possible future updates.

Individual products within the group

In literature it is described that the two largest NMVOC-emitting products in this group are deodorants and antiperspirants and hair modeling products. As these product groups cover different products with differentiated VOC-emissions, it is important to split the market statistics over the various individual products.

[15] IVAM (2005) and Ökopol (2009) mention that, according to industry, disinfectants (containing ethanol) are almost exclusively used by professionals, e.g. in the healthcare sector and hairdressing salons.

For **deodorants and antiperspirants**, this market split has been based on Ökopol (2009), based on information from Colipa/FEA, the European Cosmetics Association and the European Aerosol Association. An important advantage is the availability of the information in units, whereas in general only information in value (€) is available. The study also gives tonnages for these cosmetics which allows us to derive unit weights for the different deodorant products. These calculated figures can be used to crosscheck the weight per piece that has been estimated by using average contents and density (see for more details in section 6.2.2). The results only show minimal differences which suggests that this method could also be useful for other types of products.

Table 26: Market share (units – EU27) different deodorants and antiperspirants

Product	Share in total (%)	Units sold annually (EU27)
Aerosol spray (deodorants)	25%	549,228,000
Aerosol spray (antiperspirants)	30%	671,279,000
roll-on (alcohol-type)	2%	52,204,000
roll-on (emulsion-type)	21%	467,808,000
sticks	14%	314,673,000
pumps	7%	152,808,000
creams / gels	1%	< 1% of the market

For **hair modeling products**, a combined method has been used. Based on GfK-statistics, the market could be divided between hair sprays and other hair modeling products (gel, wax, foam) respectively. Hair sprays typically have higher VOC-contents (over 80%) and it is very relevant to separate these products from other hair styling products. A further split-up has been made between foam and waxes and gels based on shelf space in one large supermarket. Considering the similar VOC-contents of both products, an approximation of the market split seems acceptable.

Additional market assumptions based on shelf space investigation have been used for **shaving products** and **nail care products**. Units estimated by DETIC are further subdivided to shaving lather (75%) / after shave (25%) and nail polish (80%) / nail polish remover (20%) respectively. This estimation does not take into account the rotation speed of these products but nevertheless gives a rough indication of their relative importance.

6.2.1.2 Cleaning products

Product group as a whole

The DETIC-statistics for cleaning products are available in tonnage which makes it more easy to compare with other data sources. GfK-data were only requested for the largest NMVOC-contributors air fresheners, spot removers and glass and window cleaners. The definition of the product groups has been discussed with the contact persons from DETIC and GfK.

The product group of **air fresheners** is an important source for household NMVOC-emissions. On the other hand, public information for these products is rarely available. GfK-statistics show the same order of magnitude of DETIC-statistics but are still +/- 30% lower. Bilateral communication with DETIC learns that it is not entirely clear what products are covered by this category. GfK is limited to cans, electrical air fresheners, liquid wicks and gels. It is assumed that DETIC-figures also cover other relevant products e.g. the air

fresheners used in cars. This assumption is plausible as A.I.S.E., the International Association for Soaps, Detergents and Maintenance Products, includes these products in their air fresheners statistics[16].

The product range of **spot removers** consists of two different types of products, being the pretreatment products on one hand and the products that are added during the washing process. Ambient air NMVOC-emissions will originate mainly from the pretreatment products. The GfK-statistics were only requested for pretreatment spot removers as this information was not available from DETIC. DETIC only covers these products in a larger group "special textile treatment products" which also includes textile conditioners and supporting products for ironing. Combining GfK and DETIC-information shows that spot removers (pretreatment) would account for 37% of the larger DETIC- product group special textile treatment products. Own estimations based on shelf space come to a 30% share of these products.

Another important contributor to NMVOC-emissions from household products are **glass and window cleaners**. The GfK-figure is limited to cleaners for the house while first communication with DETIC states that the category should also include windscreen washing fluid for cars which could declare the higher figure (40% higher). Rough calculations on the DETIC-data however suggests that the volume can't correspond to the total product usage in Belgium. For glass and window cleaners, the GfK-data is used whilst product use for windscreen washing fluid for cars will be calculated using a bottom-up approach described in the next paragraph.

Specific information for the Brussels Capital Region has also been found for **general purpose cleaners and bathroom cleaners** in a study from CRIOC-OIVO, the *Centre de Recherche et d'Information des Organisations de Consommateurs* (CRIOC, 2001). Their survey reports that households in the BCR consume on average 12.5 liters per year (general purpose cleaners, bathroom cleaners) or 4.681.000 liter in total. DETIC-figures show a similar pattern with slightly lower consumption per household but this can be caused by the trend towards more concentrated products.

Individual products within the group

Within this product group, efforts were focused at air fresheners and spot removers. **Air fresheners** consist of a broad range of different product types with specific properties for NMVOC-emissions (e.g. instant sprays versus liquid wicks or water based gels). The figure for air fresheners (pieces) has further been subdivided to instant sprays (>28%, aerosol and other sprays), liquid wicks (>14%) and electrical air fresheners (43%) based on shelf space investigation. Gels (other 15%) were not considered because the majority of these products appears to be water-based (IVAM, 2005).

Detailed information on **spot removers** was delivered by GfK-statistics. The result has been evaluated with the results of our own shelf space investigation and confirms that +/- 30% to 40% of the DETIC category special textile treatment products corresponds with spot removers destined for pretreatment of clothes or textile.

6.2.1.3 Car products

Market data from DETIC are only available for the category car maintenance products. After communication with DETIC it is assumed that waxes, polishes, shampoos and interior maintenance (dashboard etc.) are covered. DETIC could not deliver details on the exact scope of the category.

The largest contributor to NMVOC-emissions within car products are the **windscreen washing fluids**. Public information on product use is totally lacking. Furthermore, the usage is strongly depending on weather conditions so data from other countries would not be easy transferable. IVAM (2005) mentions windscreen washing fluids as an important emission source but did not calculate NMVOC-emission as there was no information. We suggest to use a bottom-up approach based on vehicle kilometers to calculate product use

[16] Ökopol (2009)

approximately in order to cover this emission source. Average annual kilometers for Belgian passenger cars amount up to 13,262 kilometers.[17] For the purpose of this calculations (households), the figure is reconsidered for following reasons:

- in an urban environment, people drive less kilometers on annual basis. It can be calculated that inhabitants from BCR drive only 77% of the annual average in Belgium.[18]
- The average annual kilometers figure also includes company cars which drive a significant amount of work related kilometers that are not relevant for households product use. The average annual kilometers for company cars amount up to 35,000 kilometers. Taking into account the work related kilometers of these company cars would mean an additional downward correction of the average yearly kilometers with +/- 40%.

When combining the vehicle kilometers with a product use of 1 liter per 2,000 kilometer, average product use would be between 3.5 and 4.5 liter (or 1 unit as this is sold per 5 liter volume) per car per year. This figure is only a rough estimation and differs following user habits and weather conditions. Nevertheless it can be preferable to include this rough approximation rather than to leave out this emission source.

6.2.1.4 Insecticides and plant protection products

Product group as a whole

DETIC also supplied market information for this category. The figure has been compared with two studies from CRIOC on insecticides and plant protection products respectively. Plant protection usage in Belgium has been described in CRIOC-OIVO (2008) while insecticide usage has been studied in CRIOC-OIVO (2006).

The study describes a survey with 600 respondents in Belgium. The survey shows that **plant protection** products are less frequently bought in Brussels compared to Belgium in general. Only 1 to 3% of the BCR households buy plant protection products and on average 1,4 to 2,3 products are bought per year. At national level, the share of households buying this kind of products ranges between 6 and 15%.

For **insecticides**, the figure has not been differentiated between Belgium and the regions. One out of three households buys insecticides while the average amount of products bought is around 3 per year. For crawling insects, 1 on 4 households uses aerosol cans and for flying insects this ratio increases to 4 out of 5 (+/- 60% of the products bought are aerosol cans being the most important NMVOC-emission sources). When these figures are combined with Brussels population statistics, the result can be compared with the DETIC-figure. This bottom-up approach estimates the product use (tonnage) 13 % higher than the figure given by DETIC so the latter can be used for the emission inventory.

Individual products within the group

A.I.S.E, the International Association for Soaps, Detergents and Maintenance Products, has provided detailed information to Ökopol (2009) on the relative importance of water-based and solvent-based products. DETIC could not provide detailed information for Belgium so the figures for Europe have been used as an indication for BCR.

Insecticides and plant protection	Share (%)	VOC-content (%)	Content per unit (l)	Density (kg/l)
solvent-based	35%	90%	0.25	0.6
water-based	65%	45%	0.29	0.9

[17] http://www.mobilit.fgov.be/data/mobil/BrochKmSit08NL.pdf
[18] http://www.vab.be/nl/actueel/dossiers/dossiertekst.aspx?id=202
http://webfabriek.ecolife.be/downloads/voetafdrukbrusselaarsamenvatting.pdf

6.2.1.5 Furniture and leather care

At explicit request of their members, DETIC could only provide a combined market figure for **furniture and leather care products**. Individual products have been limited to (aerosol) cans for furniture and leather respectively, next to polishes and (bee) waxes for furniture and cream and (shoe) polish for leather. When comparing the bottom-up calculations (based on shelf space) from individual products to total tonnage versus the tonnage shared by DETIC, the difference is only 5%. The relative market share has subsequently been used to calculate an aggregate (weighted) VOC-content for the total product group as defined by DETIC.

6.2.2 Solvent content for different solvent containing products (SC_{SH})

For the different products information was assembled on contents per piece and weight per piece. This unit weight could be calculated by combining average contents per piece and density. This calculation was essential to be able to compare DETIC-statistics on cosmetic products with other information sources. This information is not readily available as manufacturers are not eager to share this information for several reasons. Some information on contents and densities could be found in literature, e.g. IVAM (2005) for important cosmetics products. Data gaps were covered by performing an own market study by visiting a large supermarket and writing down typical contents (per piece) for the considered products. When different volume units were available, the relative importance was estimated based on e.g. shelf space. The result is only an indication for real figures but no other public information could be found.

Density figures for cosmetic products are not easily available either. Specific requests with manufacturers have again failed to bring any information. Through extensive literature research, we have found default density values in RIVM (2002), factsheet cosmetics from the Netherlands. The quality of these values was considered to be sufficient for use as a default value (5 on a quality scale 1 to 9). In parallel, information was gathered from material safety and data sheets (MSDS) which are available for some products, more often for cleaning than for cosmetic products. Based on this information, the weight per unit of a product could be determined. The values for solvent content, selected to be used in this model are shown in Table 27.

The VOC content in these products is depending on the presence of various substances from different functional groups: fragrances, solvents, propellants, disinfectants or preservatives.

VOC-contents from **cosmetics** are well described in IVAM (2005). Ökopol (2009) has based the calculations for their impact study on these values considering some minor adaptations from Colipa, the European Cosmetics Association. The values for this study reflect the most recent updates described in Ökopol (2009). These sources did not contain any information on VOC-content in nail polish remover. A VOC content of 90% was found in RIVM (2002), factsheet cosmetics.

For **cleaning products**, the majority of VOC-contents equally originate from the same information sources. IVAM (2005) often gives a range of VOC-contents where one value in the range has been selected based on additional information sources or expert judgment. This is the case for e.g. spot removers, glass and window cleaners and some air fresheners.

An important contributor to NMVOC-emissions from **cars** is windscreen washing fluid. VOC-contents vary between summer (5%) and winter versions (30%). It is assumed that people use the winter version for two thirds (8 months) of the year. Frost risk is limited to autumn and winter season, but some people never switch between winter and summer versions.

VOC contents from leather and furniture care products are partly known from IVAM (2005). The values have been complemented with information from RIVM (2006), cleaning products factsheet for the Netherlands. These factsheets contain ingredients lists of various cleaning products. The relevant ingredients for NMVOC-emissions are propellants, solvents and turpentine oil leading to the contents in Table 27.

6.2.3 Share of the solvent emitted to air (EF_{SH})

NMVOC in products are not necessarily entirely emitted to air. The actual emission to air can be calculated by multiplying VOC use with the part emitted to air (i.e. correction factor). Detailed information on this factors are not readily available but some sources deliver estimates by evaluating how the (type of) product is used. A correction factor for the part emitted to air can be important e.g. for products used with / in water ending up in the drains. It can be argued that waste water contains VOC that will also be emitted to air. IVAM (2005) however states that only a small part of the VOC in waste water is actually ending up in the air. The study mentions that the effective VOC-emissions depend on the solubility in water. As a rule of thumb, substances with a solubility of higher than 1 mol/m³ remain solved in water, which appears to be the case for most of the substances (used in households) leading to VOC-emissions. It is therefore decided that emissions in use phase deliver by far the largest part of NMVOC-emissions from household product use. IVAM (2005) differentiates between rinse-off products and non-rinse products and assigns a correction factor to each type of product:

- Cosmetic rinse-off products: 5% to air, aerosol 50% to air
- Cosmetic non-rinse products (applied to the skin or on the hair): 85% to air, aerosol 100% to air
- Cleaning products ultimately rinsed-off: 5% to air, aerosol 50% to air
- Cleaning products applied to surfaces (non-rinse): 85% to air; aerosol 100% to air

Values, selected for this study are also shown in Table 27.

6.2.4 Allocation parameter from Belgium consumption data to BCR (ALL_{SH})

The majority of the activity data is gathered on national level for Belgium, as they are based on statistics from DETIC. For the NMVOC emission inventory, **activity data** still needs to be transferred to the BCR. Instead of using one key for transferring the figures (e.g. population), we have assigned one driver per large product group. The drivers used to transfer data from one region to another (from Belgium or other countries if appropriate) is listed below:

- Cosmetics: sales and usage driven by the number of inhabitants
- Cleaning: sales and usage driven by the number of households
- Car products: sales and usage driven by the number of households. Initially we assumed that it might be appropriate to use the number of cars in BCR. The statistic for BCR can however be distorted as many passenger cars will be registered by companies in BCR. The number of cars will also be related to the number of households which is now proposed as driver for the use of these products.
- Leather and furniture care: sales and usage driven by the number of households
- Insecticides and plant protection: sales and usage driven by the number of households

Table 27: Overview of the used VOC-contents and share emitted to ambient air for individual products

Categories	Assumption VOC-content (weight %)	Source	Assumption % emitted to air	Source
deodorants aerosols	96%	Ökopol	95%	Ökopol
roll-on	31%	IVAM	95%	Ökopol
roll-on alcohol type	55%	Ökopol	95%	Ökopol
roll-on emulsion type	6%	Ökopol	95%	Ökopol
sticks	43%	Ökopol	95%	Ökopol
deodorants (and antperspirants) pumps	90%	Ökopol	95%	Ökopol
creams / gels	6%	Ökopol	95%	Ökopol
hairspray (aerosol)	95%	IVAM	95%	Ökopol
hairspray (pump)	88%	Ökopol	95%	Ökopol
Foam	8%	Ökopol	100%	IVAM
Modelling product	13%	IVAM	85%	IVAM
Perfumes	80%	IVAM	85%	IVAM
Nail polish	80%	IVAM	85%	IVAM
Nail polish remover	90%	RIVM (2002)	85%	assumption (IVAM)
After shave	60%	IVAM	85%	IVAM
shaving lather	15%	IVAM	50%	IVAM
Hand & Body care	5%	IVAM	85%	IVAM
Face care	15%	IVAM	85%	IVAM
Shampoo and conditioner	1%	IVAM, BIPRO	5%	IVAM
Toothpaste	3%	IVAM	5%	IVAM
sun cosmetics	10%	IVAM	85%	IVAM
Hair dye - various products	5%	aggregation on IVAM	85%	IVAM
soap, bath and shower product	5%	IVAM	5%	IVAM
Hand soap	5%	assumption (IVAM)	5%	assumption (IVAM)
bath and shower products	5%	assumption (IVAM)	5%	assumption (IVAM)
Spot remover	75%	IVAM	100%	IVAM
Glass / window cleaner	15%	range (IVAM)	100%	IVAM
bathroom and tile cleaner	10%	range (RIVM, 2006)	100%	assumption (IVAM)
Air freshener aerosol	90%	range (IVAM)	100%	IVAM
Air freshener spray	25%	IVAM	100%	assumption (IVAM)
Press flacon	80%	range (IVAM)	100%	IVAM
electrical	20%	range (IVAM)	100%	IVAM
fluid (wick)	25%	assumption (IVAM)	100%	IVAM
carpet (and upholstery) cleaner	15%	range (RIVM, 2006)	100%	IVAM
General purpose cleaners	10%	IVAM, RIVM (2006)	10%	IVAM
dishwashing machine agents	1%	IVAM	5%	IVAM
dishwash agents (manual)	7%	IVAM	5%	IVAM
fabric softener	3%	IVAM	5%	IVAM
Car maintenance products (wax, polish, plastic care)	20%	assumption	85%	assumption (Ökopol)
Windscreen washing fluid	22%	summer / winter (IVAM)	100%	assumption (IVAM)
Leather and furniture care	36%	aggregation RIVM (2006)	85%	assumption (IVAM)
shoe shine and leather protection	30%	aggregation RIVM (2006)	85%	IVAM
shoe shine and leather protection - in cans (spray)	75%	RIVM (2006)	85%	IVAM
shoe shine and leather protection - other	25%	RIVM (2006)	85%	IVAM
Maintenance of furniture in cans	35%	RIVM (2006)	85%	IVAM
Maintenance of furniture - other (liquid, polish)	40%	RIVM (2006)	85%	assumption (IVAM)
glues and adhesives (solvent-based)	30%	DETIC, Ökopol, BIPRO	100%	assumption (Ökopol)
insecticides and plant protection - solvent-based	90%	Ökopol	100%	assumption (Ökopol)
insecticides and plant protection - water-based	45%	Ökopol	100%	assumption (Ökopol)

6.2.5 Calculation of appropriate EF based on emissions per inhabitant

The consumption data used for the 2008 emission inventory are not readily available and need a lot of processing before ready to use. Therefore, the extensive method used to calculate 2008 emissions is used as a basis to calculate appropriate EF for the BCR to complete their emission inventory for the past and in the future. Emissions can be calculated based on emissions per inhabitant as follows:

Emission = $\{EF_{SH} \text{ X } INH_{BCR}\}$ where:

- Emission = Emission of NMVOC from the use of a household products in kg
- EF_{SH} = Emission Factor per inhabitant for the use of a household products [g/inhabitant]
- INH_{BCR} = Number of INHabitants in BCR

6.2.6 Emission Factor per inhabitant for the use of household product [EF_{SH}]

Emission factors per inhabitant for BCR are derived for each product category by dividing total emissions per category, as calculated for 2008 (cf. Table 32 for results), by the number of inhabitants in the BCR. The emission factors are shown in Table 28. Deodorants and antiperspirants and hair modelling products clearly take a dominant position in cosmetics NMVOC-emissions. In the group of cleaning products, the emissions are more equally distributed over the different product types. Air fresheners and spot removers are the largest contributors in this group. Special cleaners comprise mainly surface cleaners, e.g. products for glass and windows or bathroom cleaners. Emissions from the use of cars are dominated by car products and almost entirely relate to the use of windscreen washing fluids.

Table 28: Calculated emission factors for VOC emissions from the use of household products in the BCR (in kg per inhabitant per year)

PRODUCT GROUPS	Type of product	EF (in kg per inhabitant per year)
Cosmetics and personal care	Cosmetics - Other products	0.07
	deodorants and antiperspirants	0.21
	Hair styling products	0.17
	Nail products	0.01
	Perfumes	0.04
	Shaving products	0.02
Cleaning products	Air freshener	0.08
	carpet (and upholstery) cleaner	0.01
	Cleaning products - general purpose	0.04
	Cleaning products - other products	0.04
	Special cleaners	0.06
	Spot remover	0.11
Car products	Car maintenance products	0.00
	Car products	0.27
Insecticides & plant protection products	Pesticides & plant protection products	0.04
Leather and furniture care	Leather and furniture care	0.03
Adhesives / DIY - consumer	Adhesives / DIY - consumer	0.02
Office products	Office products	0.00
TOTAAL		1.22

6.2.7 1990-2008

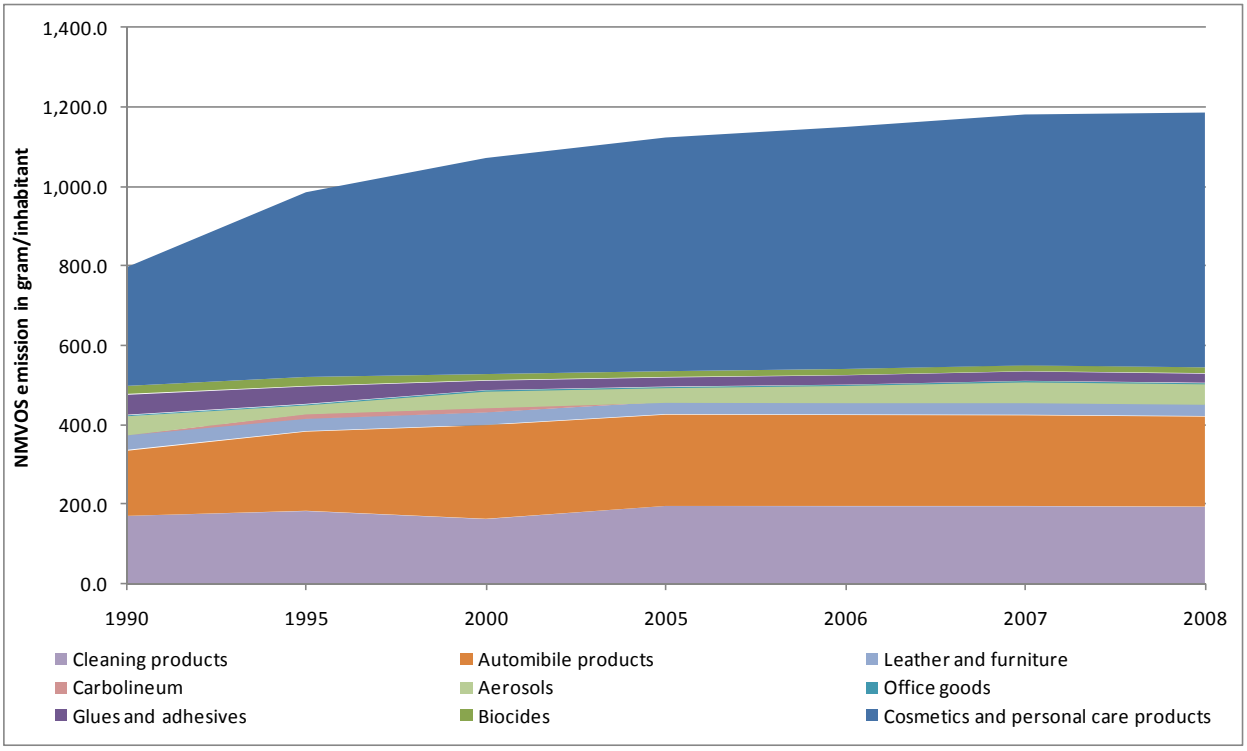
VOC-contents in household products have not been severely regulated over the past years. There is no legislation that significantly influenced the VOC-contents in cosmetics, cleaning products or other important VOC-containing household products. Evolutions are therefore largely depending on activity data and minor VOC-specific changes. Bearing in mind the recent update of the emission registration methodology (and historical recalculations) in the Netherlands, we propose to transfer the evolution for the Netherlands to BCR.

Based on the total emissions reported through ER NL, combined with the number of inhabitants in NL, emission factors (expressed as kg NMVOC per inhabitant) were calculated to be able to compare the magnitude of the emissions from household products in The Netherlands with other countries/sources. The results are shown in Table 29. The share of different product categories in the total NMVOC emission factor is visualised in Figure 8.

Table 29: Trend of the emission factors for use of solvent containing products in The Netherlands (in kg NMVOC per inhabitant)

Product	EF based on current emission inventory in NL (in g NMVOC/inhabitant)						
	1990	1995	2000	2005	2006	2007	2008
Cosmetics and personal care products	298.9	465.5	544.6	589.1	610.4	632.1	642.5
Cleaning products	172.8	185.4	165.3	197.8	197.5	197.2	195.7
Biocides	20.5	23.0	15.3	14.9	14.9	14.9	14.7
Glues and adhesives	50.5	43.3	23.4	22.8	22.8	22.7	22.6
Office goods	2.8	2.8	2.5	2.5	2.4	2.4	2.4
Automibile products	162.3	197.8	233.9	227.6	227.2	226.9	225.2
Leather and furniture	39.9	32.2	31.6	30.7	30.7	30.6	30.4
Carbolineum	0.0	12.2	11.8	0.0	0.0	0.0	0.0
Aerosols	48.0	23.1	43.0	38.1	44.2	54.3	52.8
	796	985	1,072	1,124	1,150	1,181	1,186

Figure 8: Trend of the emission factors for use of solvent containing products in The Netherlands (in g NMVOC per inhabitant)



A similar evolution of activity data can be assumed as it's a neighbouring country and culture and climate closely relate to each other. Following table shows the evolution of NMVOC-emission factors in the Brussels Capital Region for 1990-2008.

Table 30: Estimated emission factors for VOC emissions from the use of Household products in the BCR in the period 1990-2008 (in kg per inhabitant per year)

EMISSION FACTORS "DOMESTIC PRODUCTS USE"	Unit	1990	1995	2000	2005	2006	2007	2008
Total NMVOC-EF "DOMESTIC PRODUCTS USE"	kg NMVOC/inhabitant	**0.846**	**1.038**	**1.101**	**1.183**	**1.199**	**1.215**	**1.219**
Adhesives / DIY - consumer	kg NMVOC/inhabitant	0.040	0.035	0.019	0.018	0.018	0.018	0.018
Car products	kg NMVOC/inhabitant	0.197	0.240	0.284	0.276	0.276	0.275	0.273
Cleaning products	kg NMVOC/inhabitant	0.297	0.318	0.284	0.340	0.339	0.339	0.336
Cosmetics and personal care	kg NMVOC/inhabitant	0.243	0.378	0.443	0.479	0.496	0.514	0.522
Leather and furniture care	kg NMVOC/inhabitant	0.040	0.032	0.031	0.031	0.031	0.030	0.030
Office products	kg NMVOC/inhabitant	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Insecticides & plant protection products	kg NMVOC/inhabitant	0.026	0.031	0.037	0.036	0.036	0.036	0.036

For the next years (starting with 2009-2010), the emission factors can be assumed to remain constant. The largest contributors to NMVOC-emissions are cleaning products, car products and cosmetics. The market for cleaning products is a mature and highly saturated market (BIPRO, 2002) and volumes are assumed to be relatively stable, what could also be valid for car windscreen washing fluid. For cosmetics, the largest contributor to NMVOC-emissions, the market evolution (Belgium) has been studied based on figures from Colipa (yearly reports 2004-2009). The value of the market has slowly increased the last three years (between 2 and 3,2% per year). In real terms, when these growth rates are corrected for inflation it appears that the real market growth from 2006 to 2009 is limited to 0,75%. It needs to be mentioned that it is not known whether the evolutions in the cosmetics market originate from real market growth (volume) or other changes (e.g. product mix). It is therefore proposed to use the emission factors from 2008 for the next few years as no major changes are expected.

7 RESULTS 1990-2007/2008

7.1 Domestic and architectural use of paints (NFR code 3A1)

Emissions from paints are calculated based on the method explained in section 6.1 of this report. The results are shown in Table 31 and Figure 9. Note that sales data are not yet available for 2008 and thus the most recent year that could be calculated was 2007.

Table 31: Total NMVOC-emissions from domestic and architectural use of paint in the Brussels Capital Region in the period 1990-2007 (in tons NMVOC)

DOMESTIC AND ARCHITECTURAL USE OF PAINT	1990	1995	2000	2005	2006	2007
Domestic WB	66.303	63.865	67.476	47.655	40.896	63.178
Domestic SB	206.658	199.060	197.547	197.727	147.640	203.271
Architectural WB	161.314	160.142	177.274	145.200	144.446	140.281
Architectural SB	502.796	499.144	518.994	602.459	521.464	451.340
TOTAL DOMESTIC USE	272.961	262.925	265.023	245.381	188.536	266.449
TOTAL ARCHITECTURAL USE	664.110	659.287	696.267	747.659	665.910	591.621
TOTAL EMISSIONS (in TONS)	**937.070**	**922.212**	**961.290**	**993.041**	**854.447**	**858.070**

Figure 9: Total NMVOC-emissions from domestic and architectural use of paint in the Brussels Capital Region in the period 1990-2007

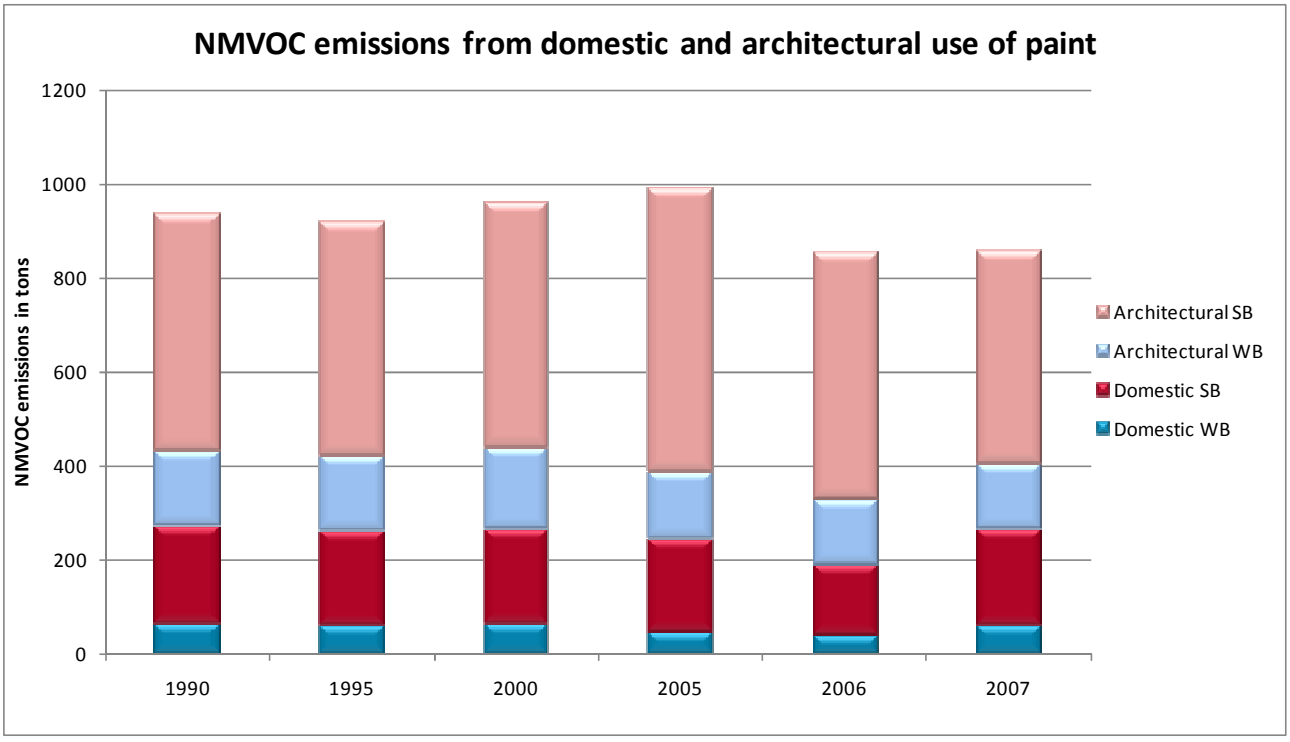


Figure 9 shows a slight increase in emissions during the period 1995-2005, due to higher consumption of paint. A Decreasing trend in NMVOC emissions from the use of paint is shown after 2005. This decreasing trend is due to decrease in emissions from solvent based paint. This decrease is due to a combination of a decrease in the share of SB paints in total and the decrease of the solvent content. The emission from water based paints remain more or less the same. The increase in 2007 in emissions from domestic use of solvent based paint is specifically due to an increase in the share of the BCR in the total Belgian emissions. The

share of emissions from architectural use of paint is about 70% of the sum of emissions from domestic and architectural use.

7.2 Domestic solvent use (NFR code 3D2)

NMVOC-emissions for the Brussels Capital Region have been calculated by combining activity data for Belgium from DETIC-statistics and some alternative sources (with specific data for BCR). For de-icers (cars) and office products, the VOC emissions have been based on the value calculated for the Netherlands in IVAM (2005) and the Emission Registration respectively. The detailed emission inventory study has been performed for the year 2008.

Cosmetics are the largest contributor to NMVOC-emissions with nearly 43% of total emissions from households. Other important sources are cleaning products (including air fresheners) and car products. The other product groups are responsible for less than 10% of total emissions.

The ranked results for the evaluated household products are shown in Table 32. As described in various literature sources, the majority of NMVOC-emissions from household products use can be attributed to a small number of products.Together, the top 10-products account for nearly 75% of the total NMVOC-emissions in the Region. Aerosol deodorant and hair sprays account for 26% of all emissions and a large share of cosmetics. The use of windscreen washing fluids causes 20% of NMVOC-emissions. Within the group of cleaning products, spot removers can be considered as the largest emission source.

Table 32: NMVOC-emission from the use of household products (no paints) in the Brussels Capital Region (2008)

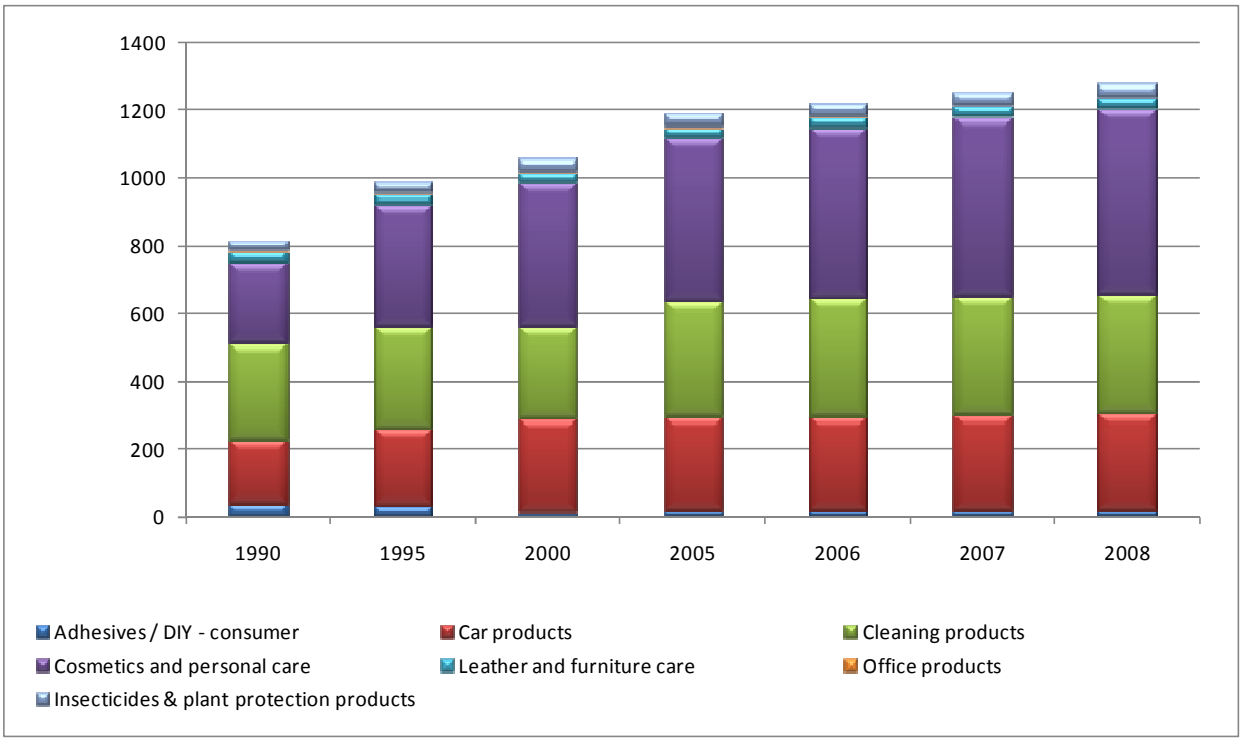
PRODUCTS	PRODUCT GROUP	NMVOC-emission (in kg)
Windscreen washing fluid	Car products	258,752
deodorants aerosols	Cosmetics and personal care	182,764
hairspray (aerosol)	Cosmetics and personal care	153,517
Spot remover	Cleaning products	118,213
Air freshener aerosol	Cleaning products	54,114
Perfumes	Cosmetics and personal care	44,316
General purpose cleaners	Cleaning products	41,556
Glass / window cleaner	Cleaning products	35,614
dishwash agents (manual)	Cleaning products	33,678
Leather and furniture care	Leather and furniture care	31,697
Hand & Body care	Cosmetics and personal care	28,479
De-icer	Car products	25,875
Face care	Cosmetics and personal care	23,719
bathroom and tile cleaner	Cleaning products	23,099
deodorants (and antperspirants) pumps	Cosmetics and personal care	19,411
solvent-based	Pesticides & plant protection products	19,380
fluid (wick)	Cleaning products	19,271
glues and adhesives (solvent-based)	Adhesives / DIY - consumer	18,897
water-based	Pesticides & plant protection products	17,995
Modelling product	Cosmetics and personal care	16,754
shaving lather	Cosmetics and personal care	13,000
sticks	Cosmetics and personal care	10,955
Air freshener spray	Cleaning products	10,278
sun cosmetics	Cosmetics and personal care	9,082
After shave	Cosmetics and personal care	8,207
hairspray (pump)	Cosmetics and personal care	7,442
carpet (and upholstery) cleaner	Cleaning products	7,290
Hair dye - various products	Cosmetics and personal care	7,225
fabric softener	Cleaning products	7,036
Nail polish remover	Cosmetics and personal care	6,625
Foam	Cosmetics and personal care	5,159
Office products	Office products	3,145
roll-on emulsion type	Cosmetics and personal care	2,492
roll-on alcohol type	Cosmetics and personal care	2,176
Nail polish	Cosmetics and personal care	1,820
electrical	Cleaning products	1,788
Hand soap	Cosmetics and personal care	1,772
Car maintenance products (waxes, polishes, plastic care)	Car products	1,688
bath and shower products	Cosmetics and personal care	1,407
Toothpaste	Cosmetics and personal care	760
Shampoo & conditioner	Cosmetics and personal care	542
dishwashing machine agents	Cleaning products	482
creams / gels	Cosmetics and personal care	119
TOTAAL		1,277,592

The results (only on aggregate level) for the period 1990-2008 are shown in Table 33 and Figure 10. All results for the base year 2008 are evaluated by making a comparison with historical inventories for BCR (and Belgium by extension) and data from other (literature) sources.

Table 33: NMVOC-emission from the use of household products (no paints) in the Brussels Capital Region (1990-2008) – by product group (in tons NMVOC)

DOMESTIC USE OF SOLVENT CONTAINING PRODUCTS	1990	1995	2000	2005	2006	2007	2008
Adhesives / DIY - consumer	38.90	32.90	17.96	18.34	18.53	18.73	18.90
Car products	189.82	228.28	272.16	277.88	280.71	283.74	286.32
Cleaning products	286.23	302.99	272.38	342.04	345.52	349.25	352.42
Cosmetics and personal care	234.39	360.14	424.79	482.21	505.64	530.00	547.74
Leather and furniture care	38.25	30.43	30.13	30.76	31.08	31.41	31.70
Office products	3.29	3.28	2.99	3.05	3.08	3.12	3.15
Insecticides & plant protection products	24.78	29.80	35.53	36.27	36.64	37.04	37.38
Total EMISSIONS (IN TONS)	815.66	987.83	1055.93	1190.56	1221.21	1253.28	1277.59

Figure 10: NMVOC-emission from the use of household products (no paints) in the Brussels Capital Region (1990-2008) – by product group



7.2.1 Comparison with the current method used by BIM

When comparing the results with the emission factor of 1.984 kg/inhabitant currently used by BIM, it is found that the calculated overall emission factor 1.22 kg/inhabitant is significantly lower (39%). The composition of the currently used EF is described in VITO / Econotec (2000). Whether this significant decrease is acceptable/realistic, is assessed by checking the applicability/reliability of the current emission factor used (1,984 kg/inhabitant). Following issues can be raised:

- The basket of products included in both EF is not always comparable
- The EF reported in the VITO / ECONOTEC study for The Netherlands (1994) is not used anymore to calculate emissions from household product in The Netherlands, not even for the period 1990-2000

The VITO/ECONOTEC report (2000) indicates that the figures for the Netherlands are based on KWS2000 yearly reports (infomil, 1992-). Within the KWS2000 program, VOC-emissions from household products use are reported together with VOC-use from industrial, institutional and professional actors (HIIP-sector). It is

therefore plausible that the reflected higher emission factors are not limited to product use from households. Moreover, the VITO/ECONOTEC-study suggests to use 1994 emission factor values instead of the lower values from 1998 (1.297 kg per inhabitant) by reasoning that there was a large decrease in NMVOC-emissions as a consequence of measures within the KWS2000 program (not implemented in Belgium). This argument seems plausible, but bilateral communication between VMM and the Dutch *Planbureau voor de Leefomgeving* indicates that the measures from the KWS2000 program have primarily focused on producers rather than on consumers. No real measures were implemented for important consumer products like cosmetics, cleaning products or car products (A description of the implementation of certain measures within Household, institutional and industrial products is given in the KWS2000 final report (2002).

The proposed inventory results in paragraph 6.2.6 refer only to NMVOC-emissions from product use in households. DETIC confirmed that the delivered market data comprised only consumer and household sales and no professional products. The same applies for GfK-statistics as these results are based on a sample of real household expenditures.

In IVAM (2005), some information has been mentioned on the distribution of product use to consumers and professional users. For cosmetics, 10% of the product use could be attributed to professionals for those products that are used in hairdresser salons, nail salons and beauty parlours. Considering the IVAM-estimations for cleaning products, it can be calculated that roughly 60% of the emissions could be attributed to households (e.g. the study mentions the significance of product use by professionals for some important products: air fresheners, spot removers, glass/ window cleaners and carpet cleaners). When these correction factors are applied to the currently used EF of 1.984 kg / inhabitant, the EF would decrease to 1,775 kg/inhabitant. Within the group of cleaning products, the current EF also includes white spirit and thinners. According to IVP, these products are less relevant today as the majority of the paints for consumers are water-based. The EF could therefore be further adapted to 1.54 kg/inhabitant. The difference with the newly calculated EF then drops to about 21 %.

Comparing the emission factors presented in the VITO/ECONOTEC study (cf Table 3) with EF currently used in The Netherlands, it looks like the emission factors from Table 3 are not used anymore in the current emission inventory. The result of this comparison is shown in Table 34. Indeed the EFs for the Dutch Emission Register are systematically updated by the Task force on Consumers and other sources of emissions. This Task Force covers emissions caused by consumers, trade and services. The members are emission experts from Netherlands Environmental Assessment Agency, the Netherlands Organisation for Applied Scientific Research and Statistics Netherlands. The VITO/ECONOTEC study concluded that the Dutch EF are applicable to Belgium/BCR. Since for Belgium, there has not been an updated check of the 1994 EF after the VITO/ECONOTEC study, it is acceptable to assume that the EF, currently used in the Dutch Emission Register will be more reliable than the 1994 estimations.

The text after Table 34 summarises some explanatory details on why the EF in the Dutch Emission Registration were updated.

Table 34: Comparison of EF for NMVOC-containing household products, as suggested in 1994 in The Netherlands and EF calculated from the current emission inventory for 1990, 1995 and 2008 (in kg NMVOC per inhabitant)

Product	EF based on current emission inventory in NL (in g NMVOC/inhabitant)			EF for NL (1994) on which EF for BIM is based in the existing emission inventory for BIM (Table 3)
	1990	1995	2008	1994
Cosmetics and personal care products	298.9	465.5	642.5	454.2
Cleaning products	172.8	185.4	195.7	609.9
Biocides	20.5	23	14.7	110.3
Glues and adhesives	50.5	43.3	22.6	304.9
Office goods	2.8	2.8	2.4	19.5
Automobile products	162.3	197.8	225.2	207.6
Leather and furniture	39.9	32.2	30.4	32.4
Carbolineum	0	12.2	0	19.5
Aerosols	48	23.1	52.8	/
TOTAL	796	985	1,186	1758.2

Following updates of the EF were described in the background documents of the Dutch Emission Registration for consumer products:

- **Cosmetics and personal care products: this category includes following products:**
  - Hairspray
  - Deodorants,
  - Perfumes
  - Nail polish (remover)
  - Aftershaves
  - Other products

  The emission factors as shown in Table 3 (1994) are comparable with the emission factors currently used in the Dutch emission inventory for 1995. Therefore we can conclude that the emissions calculated for the BCR for 1994 are correct. Table 34 shows that the emission factor increases from 1990 to 2008. Reasons can be:
  - An increase due to an increase in consumption or shift in consumption pattern
  - For deodorants a shift towards higher VOC containing products
  - On the other hand, emissions from the use of aftershaves were reduced from 1981 to 1996 with 30% already

- **Office goods**: in 1996, a new study was performed on the emissions of NMVOC from office goods by Haskoning/PMA, in which 5 product categories were taken into account:
  - Ball penns
  - Text markers
  - Correction liquids
  - Computer cleaners
  - Inkjet inks

Based on enquiries of 30 parties and chemical analyses of 18 representative products, emissions for the year 1994 were estimated 87 tons (instead of the 285 tons based on the EF from Table 1 (as shown also in Table 34). This important decrease was not fully explainable but according to InfoMil there was a decreasing trend in the use of such materials between 1990 and 1994 and the estimation of the emissions for 1994 appeared to be too high.

- **Glues and adhesives**: The emissions presented in the current emission inventory are based on monitoring data for NMVOC-content of glues and adhesives. Marketing data shows a quite stable market between 1991 and 1995. Since 1996 a reduction in NMVOC-content of glues is taken into account of 4.6% per year (due to stimulating the use of low-NMVOC glues). The decrease from 304.9 as suggested in the 1994 report to the use of 50.5 and 43.3 for 1990 and 1995 respectively in the current emission inventory is unclear. *We assume that the 1990 data were adjusted based on the new monitoring and marketing study in 1995, assuming that the evolution between 1990 and 1995 couldn't be this important.*

- **Cleaning products**: relevant product groups are:
  - Spiritus
  - Spot remover
  - Window cleaner
  - Hand soap
  - Air freshener
  - Carpet cleaner
  - Medical hand desinfectants
  - Ammonia
  - Terpentine

7.2.2 Cross-checks with alternative sources

The calculated NMVOC-emissions can be compared with other information sources that give information on product level or for larger product groups. The results are benchmarked with DETIC reports from 2004 and with the emission inventory from the Netherlands.

In 2004, DETIC has published three reports on volatile organic compounds in detergents, cosmetics and adhesives. The results of these documents have already been described in paragraph 4.2.1. The NMVOC estimates *for Belgium* from these reports can be roughly summarised as follows:

- Cosmetics: 4.16 kilotons per year.
- Detergents as a group within cleaning products: 410 tons emitted to air
- Adhesives: 166 tons

NMVOC-emission calculations performed within this study for **cosmetics** (Belgium) result in 5.6 kilotons per year. The reported DETIC-estimates are based on 2002 figures. The cosmetics market has known a continuous growth in the first decade of 2010. No figures for Belgium (starting from 2002) have been found but an indication of this evolution could be based on the yearly reports from NCV, the Cosmetics Association in the Netherlands. The market has shown a yearly growth in monetary terms since 2002, with only one negative evolution from 2004 to 2005. When these growth figures are corrected with inflation, the total growth over 2002-2008 can serve as an approximation for the volume growth in the cosmetics market (+12%). Increasing the 2002 estimate from DETIC leads to extrapolated emissions of +/- 4.7 kilotons per year, which is 15% lower than the calculation in this study. DETIC has limited their estimates for **cleaning**

products to detergents and reports 410 tons of NMVOC emissions originating from these products. When air fresheners and spot removers are excluded from the calculations in this study, NMVOC-emissions (to air) from cleaning products "detergents" are estimated at 1.300 tons or 3 times higher than the DETIC estimate. For adhesives, the calculations are resulting in the same amount of emissions (+/- 170 tons) as all parameters used are delivered by DETIC.

The inventory calculations can also be benchmarked against the emission registration data from the Netherlands (see section 6.2.7). Results for both the Brussels Capital Region and for the Netherlands are shown in Table 35.

Table 35: Comparison of proposed emission factors (kg / inhabitant) with values from the Netherlands

PRODUCT GROUPS	kg NMVOC / inhabitant	
	BCR (2008)	ER NL (2008)
Adhesives / DIY - consumer	0.018	0.023
Car products	0.273	0.225
Cleaning products	0.336	0.196
Cosmetics and personal care	0.522	0.643
Leather and furniture care	0.030	0.030
Office products	0.003	0.002
Insecticides & plant protection products	0.036	0.015
Aerosols		0.053
TOTAAL	1.219	1.186

The proposed *total* NMVOC-emissions for BCR are very similar to the values for the Netherlands. Emissions from cosmetic products in the Netherlands (54% of total emissions) appear to be higher than the emissions for BCR (44%) while the inverse situation is found for cleaning products (16% in the Netherlands versus 28% in BCR). It is unclear whether the separate category for aerosols could also be attributed to cleaning products (additional 4% of total emissions). For both the Brussels Capital Region and the Netherlands, cleaning products and cosmetics emit together over 70% of NMVOC-emissions from product use in households.

Due to the lack of data and the variety of products, NMVOC-emissions from air fresheners were not easy to compute. One additional information source[19] for the Netherlands states that **air fresheners** account for 20% of the NMVOC-emissions from cleaning products in the Netherlands, adding up to +/- 2000 kilotons VOC per year. Calculations within this study generate approximately 800 kilotons NMVOC-emissions from air fresheners in Belgium. This figure can be plausible assuming a higher market penetration of these products in the Netherlands. In the Brussels Capital Region, air fresheners account for 24% of all NMVOC-emissions from cleaning products coming close to the figure found for the Netherlands.

[19] www.milieucentraal.nl

8 FUTURE SCENARIO

8.1 Paint

8.1.1 Description of likely evolutions

The values for the different parameters used in the formula for estimating the emissions in 2020 are defined as described in the following sections.

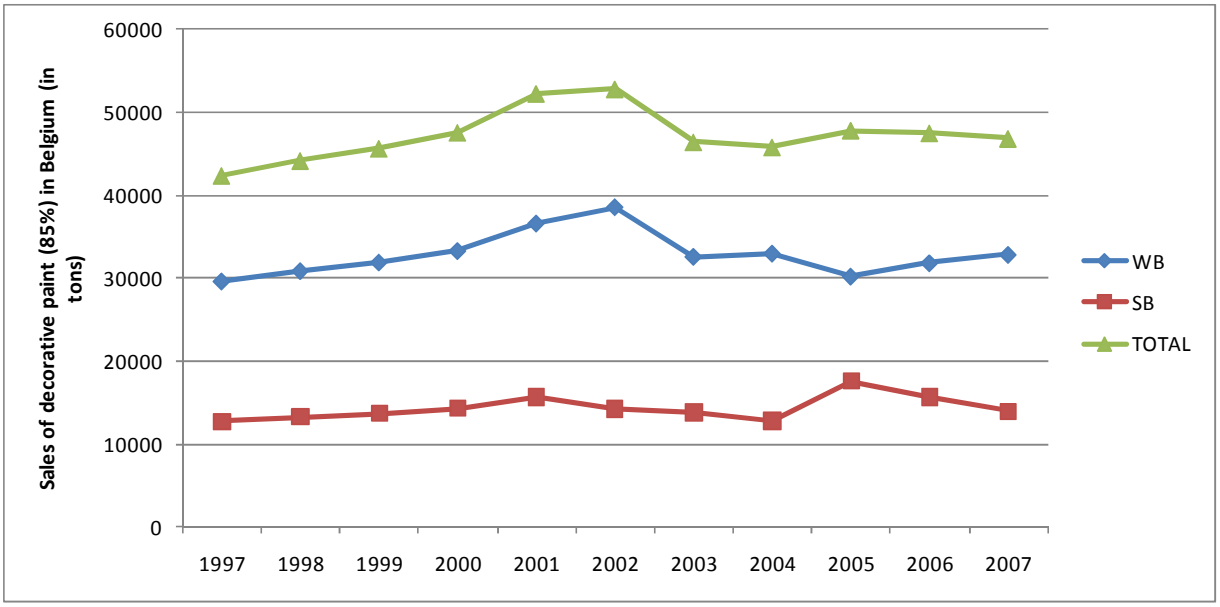
A_{DP} = Total sales of Decorative Paint in Belgium [kg]

The evolution of the sales data (source: IVP) for WB and SB paint in Belgium is given in Figure 11. This figure shows that:

- Total sales of paint in Belgium increased from 1997 to 2002 and after an important decrease in 2003, total sales remain at quasi the same level between 2003 and 2007
- The use of WB and SB paints increased during the period 1997-2001, for WB paints this increase went on until 2002
- From 2002 till 2005 an decrease in WB paints is identified, for SB paints the decrease only lasted until 2004 and between 2004 and 2005 an important increase is noted
- Since 2005 there is an decrease in sales of SB paints in favour of a decrease in sales of WB paints.

CEPE estimates in the period beyond 2010 a share for WB paints of 87.7% and for SB paints of 12.3%. For 2020 we assume that the total sales of paint are at the same level as in 2007.

Figure 11: Evolution of the sales data of WB and SB paint in Belgium for the period 1997-2007 (source: IVP)



F_{CON} = Fraction of Decorative Paint in Belgium used by consumers [-]

RAINS assumes that in 2010, 32.7% of total sales are for consumer use. Since no specific data are available for 2020, we assume that this allocation remains the same between 2010 and 2020.

F_S, F_W = Fraction of solvent-based and water-based paint in total paint sold [-]

IVP data make a distinction between WB and SB paint, which makes the calculation of these fractions unnecessary.

SC_S, SC_W = Solvent Content of solvent-based and water-based paint [kg solvent/kg paint]

CEPE provided estimations of solvent contents for the period "beyond 2010" (see Table 10). We assume that these suggestions are representative for the situation in 2020.

ALL_{BCR} = Allocation parameter from Belgium to Brussels Capital Region

We assume that the difference between the 3 regions in expenses for paint by consumers per household remains the same in the future, therefore we use the 2007 data for expenses for paint as a basis to calculate the allocation parameter for 2020. Even though the expenses can increase due to increasing consumer prices, this would not influence the allocation parameter and thus using the 2007 data as a basis is acceptable. Based on a study from the Federal Planning Bureau – Economic Analyses and forecasts services, an increase of the number of households in Belgium between 1990 and 2030 of 996000 was suggested. Since no specification is available of the change in households in the different region, we assume the same trend in the 3 regions and thus result in an equal allocation parameter for 2020 as for 2007.

To fill out the calculation tool, we used following data: Taking into account the real increase between 1990 and 2008 of 610714 households, we can assume an increase between 2008 and 2020 of about 17468 households a year. This brings our estimation on about 4779130 households in Belgium in 2020. Using the same distribution of the total number of households in Belgium to the 3 regions as in 2008, we can estimate that in 2020 the number of households in the BCR will be 544448. The combination of the number of households in the different regions and the expenses for paint, brings us to an allocation parameter for 2020 of 9.4%.

8.1.2 2020 projections

The possible future developments, as described in the previous section, were implemented in the calculation model. The values assumed are shown in Table 36.

Table 36: Values used to estimate NMVOC-emissions from the use of decorative paint in BCR (2020)

		ACRONYM	UNIT	VALUE
Total use of Decorative paint in Belgium				45893232
	Water based (WB)	ADP,WB	Liter	40248364
	Solvent based (SB)	ADP,SB	Liter	5644868
Solvent content				
	Water based (WB)	SCWB	g NMVOC/Liter	48
	Solvent based (SB)	SCSB	g NMVOC/Liter	412
Fraction Consumer use in total decorative paint				
	Domestic use	F_{CON}	-	0.327
	Architecural use	F_{PROF}	-	0.673
Allocation parameter for consumer use from Belgium to BCR				
	Domestic use	$ALL_{BCR, CON}$	-	0.094
	Architecural use	$ALL_{BCR, PROF}$	-	0.118

Based on these assumptions, total emissions from the use of decorative paint in BCR in 2020 are calculated at 469 ton. The results are shown in Table 37

Table 37: Estimated NMVOC-emissions (in tons/year) from the use of decorative paint in BCR (2020)

	2020
Domestic WB	59.509
Domestic SB	71.639
Architectural WB	153.422
Architectural SB	184.692
TOTAL DOMESTIC USE	131.148
TOTAL ARCHITECTURAL USE	338.114
TOTAL EMISSIONS	469.262

8.2 Household products

Future NMVOC-emissions from domestic product use are difficult to estimate as they should include market and technical evolutions, whereas information on both is totally lacking. Ökopol (2009) has performed an impact assessment study on a possible review of Directive 2004/42/EC extending the scope to other product categories than paints. There appears to be little consensus however on the likely evolutions. The impact assessment study has focused on the largest NMVOC-emission sources, as measures for these products would bring about the largest reductions. Technical limitations and the lack of consumer acceptance for alternative products seem to hinder the proposed options. For the purpose of this study, the most plausible regulations for important contributors have been considered.

8.2.1 Description of likely evolutions

Within the group of cosmetics products, hairsprays and deodorant sprays have by far the largest NMVOC-emissions. One far reaching option (with high potential VOC-reductions) that has been studied in the Ökopol impact assessment study was the introduction of a VOC limit value of 10% for all **deodorant products**. The report concludes however that the measure is not recommended because of the limited acceptance at consumer level because people do not seem to be eager to switch to sticks or rollers instead of sprays. It appears that the option is not realistic and irrelevant for future projections of NMVOC-emissions. For **hair sprays**, the proposed reduction option was a decrease in VOC-content from 95% to 90%. Stakeholder consultation learned that this could be realistic and no major shifts in demand are expected. The impact for the Brussels Capital Region will be calculated assuming a stable market and population projections for 2020. An additional measure for both hairsprays and deodorant sprays is the compulsory labelling of the VOC-content, clearly visible on the front of each product. This measure is expected to cause a shift in demand to alternative products. For BCR, we assumed a 25% diversion[20] of demand to other alternative products, distributed to these products according to their current market shares.

Within the group of cleaning products, there are no products taking a similar dominant position as for cosmetics. For **air fresheners**, one option could be to shift away demand from electrical air fresheners (VOC-content 5-30%) to water-based gels. Based on other studies, the report concludes that “electricals” have some important advantages and the gels are no substitutes for these products (large rooms, can be turned off, adjustable supply). Evolutions for air fresheners are therefore highly uncertain and no changes

[20] Ökopol (2009) studied 4 scenarios: 10%, 20%, 30% and 40% shift in demand

are considered for BCR. The report does include a reduction measure for **glass and window cleaners**, which currently shown VOC-contents ranging from 5 to 20%. A VOC-content reduction to 5% seems realistic and feasible and will be calculated for BCR. A further reduction of the content would compromise the effectiveness of the cleaning product.

For the largest contributor to NMVOC-emission, **car windscreen washing fluids**, additional regulations are difficult to consider. The products already contain the minimum levels of VOC in order to be functional, being 5% for the summer version and 30% for winter versions. The reduction potential for this product is however not negligible as people might limit their consumption of the winter versions with higher VOC content. E.g. through information campaigns, people could be motivated to switch to summer versions whenever possible. For BCR, the impact will be considered if people only use the winter version 5 months a year (with frost risk) instead of 8 months per year that has been assumed for the current situation.

8.2.2 2020 projections

The possible evolutions described in 8.2.1 were implemented in the calculation model. A stable market has been assumed for all products, only reflecting the evolution of the population towards 2020 (number of inhabitants and households). For those cosmetic products (aerosol) where the expected measures affect their market share, the figures have been adapted. The results of this exercise are shown in Table 38:

Table 38: Projected NMVOC-emissions for BCR (2020)

	Emission Factor (in kg per inhabitant per year)		NMVOC emissions BCR 2020 (in kg)	
Product groups	Year 2020	Year 2008	BAU	selected options
Adhesives / DIY - consumer	0.018	0.018	21,629	21,629
Car products	**0.195**	0.273	327,718	233,741
Cleaning products	**0.313**	0.336	403,381	376,205
Cosmetics and personal care	**0.506**	0.522	626,949	607,484
Leather and furniture care	0.030	0.030	36,280	36,280
Office products	0.003	0.003	3,600	3,600
Insecticides & plant protection products	0.036	0.036	42,780	42,780
TOTAAL	1.101	1.219	1,462,338	1,321,720

The first two columns of the table are reflecting the calculated emission factors for 2008 and for the year 2020, assuming that the described measures and regulations from section 8.2.1 would be implemented. The largest potential reduction comes from the product group car products and could be achieved if people change their habits to switch over to the summer version of car windscreen washing fluids whenever possible. The reduction potential is however still highly depending on weather and climate conditions. Cleaning products and cosmetics also show a modest decline of the emission factor per inhabitant, due to the proposed measures for glass and window cleaners and aerosol sprays (deodorants and hair) respectively. By implementing all these measures, more than 10% of NMVOC-emissions could be reduced as opposed to the situation where nothing will be done (BAU, Business-as-usual). The exercise could not consider specific market evolutions or technical and product innovations as no information is available.

9 LIMITS, SUGGESTIONS, RECOMMENDATIONS

Limits of the methodology are the following:

- Sales data for paint are only available on Belgian level and need to be allocated to the BCR
- VOC-contents of paints are not monitored yearly and are based on assumptions of the trend
- For other household products this is also the case but here no significant change in VOC-contents are expected in the future
- Due to some gaps in data for individual household products, some assumptions have to be made, based on very limited information

Suggestions are:

- To gear the methodologies used by the different regions to one another
- To review the VOC-contents suggested in this study on a regularly basis

REFERENCES

Anoniem (2009). Lozingen in de lucht 1990-2008. Vlaamse Milieumaatschappij, Erembodegem

BIM (2006). Verslag over de staat van het leefmilieu in Brussel in 2006: Buitenlucht

BIPRO (2002). Screening study to identify reductions in VOC emissions due to the restrictions in the VOC content of products

CEIP (2009). Guidelines for reporting emission data under the Convention of Long-range Transboundary Air Pollution. Annex IV version 30/9/2009. (ECE/EB.AIR/97). A spreadsheet containing reporting table templates for the UNECE/EMEP 2009.

CITEPA (2009). Organisation et méthodes des inventaires nationaux des émissions atmosphérique en France:, 6ème edition. Report written by the **C**entre **I**nterprofessionnel **T**echnique d'**E**tudes de la **P**ollution **A**tmosphérique.

Colipa activity reports 2004 - 2009

CRIOC-OIVO (2008). Le jardinière et les moyens de lutte.

CRIOC-OIVO (2006). Producten tegen insecten, ongedierte en parasieten.

CRIOC-OIVO (2001. allesreinigers en sanitaire reinigers.

DETIC (2004). Vluchtige organische componenten in cosmetische producten.

DETIC (2004). Vluchtige organische stoffen in detergenten

DETIC (2004). Vluchtige organische stoffen in kleefstoffen

ECONOTEC / VITO (2000). Preparation of a policy to reduce the emissions of VOC from products. Part I: inventory. Study commissioned by Federale Diensten voor het Leefmilieu.

Emission registration Netherlands (2010). Emission data, methodology reports and metadata available on: www.emissieregistratie.nl

European Environmental Agency (2007). EMEP/CORINAIR Emission Inventory Guidebook

Fauser Patrik, Saarinen Kristina, Harðardóttir Kristín, Kittilsen Marte O., Holmengen Nina, Skårman Tina (2009). Improvement of Nordic Emission Models for Solvent Use in Selected Sectors.

Holmengen, N. and Kittilsen, M.O. 2009. Estimating emissions of NMVOC from solvent and other product use, Revised model, Statistics Norway, 77 pp.

KWS2000, eindrapportage / final report. Infomil 2002. www.infomil.nl

NCV (2009). Jaarverslag

OIVO (xxx). Een huishoudelijke schoonmaak zonder gevaarlijke producten en zonder gevaarlijk afval: technisch rapport.

Okopol (2009). Implementation and review of Directive 2004/42/EC

RIVM (2002). Factsheet cosmetica. Ten behoeve van de schatting van de risico's voor de consument.

RIVM (2006). Cleaning Products Fact Sheet To assess the risks for the consumer.

Skårman Tina, Danielsson Helena, Henningsson Emma, Östman Margareta, Swedish Chemicals Inspectorate (2006). Revised Method for Estimating Emissions of NMVOC from Solvent and other product use in Sweden. Assignment for Swedish Environmental Protection Agency

Theloke, J., Friedrich, R. (2003). Development of an improved product based approach for the calculation of NMVOC emissions from solvent use in Germany and uncertainty analysis. Paper presented at the 12th International Emission Inventory Conference "Emission Inventories - Applying New Technologies," San Diego, April 29 - May 1, 2003. www.epa.gov/ttn/chief/conference/ei12/area/theloke.pdf

VMM (2010). Personal communication from E. De Brabanter

VROM (2008). Monitoringsysteem uitvoering EU-richtlijn verfproducten. Rapport opgesteld door COT, Haarlem.

ARCADIS

Offices ARCADIS Belgium Offices ARCADIS Engineering & Consulting		www.arcadisbelgium.be
Deurne-Antwerp Clara Snellingsstraat 27 B-2100 Deurne-Antwerp T +32 3 360 83 00 F +32 3 360 83 01	Berchem-Antwerp Roderveldlaan 3 B-2600 Berchem T +32 3 328 62 86 F +32 3 328 62 87	Kortrijk Sint-Jorisstraat 21 B-8500 Kortrijk T +32 56 24 99 20 F +32 56 24 99 21
Ghent Kortrijksesteenweg 302 B-9000 Ghent T +32 9 242 44 44 F +32 9 242 44 45	Haaltert Bruulstraat 35 B-9450 Haaltert T. +32 53 83 04 80 F.+32 53 83 59 54	Leuven Vaartkom 31/8 B-3000 Leuven T +32 16 63 95 00 F +32 16 63 95 01
Hasselt Eurostraat 1 bus 1 B-3500 Hasselt T +32 11 28 88 00 F +32 11 28 88 01	Oostende Archimedesstraat 7 B-8400 Oostende T +32 59 27 38 00 F +32 59 27 39 00	Brussels 500, avenue Louise B-1050 Brussels T +32 4 349 56 00 F +32 4 349 56 10
Liège 26, rue des Guillemins, 2ème ét. B-4000 Liège T +32 4 349 56 00 F +32 4 349 56 10	Charleroi 119, avenue de Philippeville B_6001 Charleroi T.. +32 71 298 900 F. +32 71 298 901	Bastogne 6, rue Thier De Luzéry B-6600 Bastogne T +32 61 21 38 85 F +32 61 21 52 28