EUROPEAN COMMISSION SERVICE CONTRACT
N°070307/2007/483710/MAR/C3

IMPLEMENTATION AND REVIEW OF DIRECTIVE 2004/42/EC

(EUROPEAN DIRECTIVE LIMITING THE VOC CONTENT IN CERTAIN PRODUCTS – CURRENT SCOPE: DECORATIVE PAINTS AND VARNISHES, VEHICLE REFINISHING PRODUCTS)

FINAL REPORT (2 PARTS)
PART 1: MAIN REPORT, ANNEXES 1-25
10 NOVEMBER 2009

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EUROPEAN COMMISSION SERVICE CONTRACT N°070307/2007/483710/MAR/C3

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FINAL REPORT – PART 1: MAIN REPORT, ANNEXES 1-25

DRAFT VERSION: 21 MAY 2009, COMMENTED: 8 JUNE 2009
1ST FINAL VERSION: 21 JUNE 2009, COMMENTED: 17 JULY 2009
2ND FINAL VERSION: 25 AUGUST 2009, COMMENTED: 26/27/28 AUGUST 2009
3ND FINAL VERSION: 28 SEPTEMBER 2009, COMMENTED: 9 OKTOBER, 1/10 NOVEMBER 2009
4TH FINAL VERSION: 10 NOVEMBER 2009

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This report represents the views of Ökopol and its project partners and in no way reflects the views of the European Commission.

The technical background information of this report was supported by Member State authorities and industrial stakeholders, in particular by European industry associations and individual companies related to VOC containing products. We appreciate very much all their contributions to the study.

In particular, we would like to thank CEPE staff and working group members for their input on several types of coating products. Furthermore, we thank AIRC, CECRA and UNIEP for their feedback on coatings regulated under the scope of the current directive, Colipa for information on cosmetics, FEICA for information on adhesives, A.I.S.E. for information on glass cleaners and insecticides, FEA and AEROBAL for information on aerosol products, EURMIG for information on yachts coatings, CEFIC-CES for information on water-repellant impregnation products, and all other associations, individual companies and research institutes for their efforts in support of the project.

CONTENT OVERVIEW

Executive summary

This report was elaborated in the context of a service contract between the European Commission and a project consortium lead by Ökopol/Germany, supported by IVAM/Netherlands, RPA/UK, IER/Germany and REC/Hungary.

The report provides background information and amendment proposals for the Commission for preparation of the future review of Directive 2004/42/EC[1].

Background of the project

From 1.1.2007 on, Directive 2004/42/EC has determined the maximum solvent content of two product groups, which are normally used under conditions where no secondary VOC emission reduction measures are taken. 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 product related directive complements other national and European measures for VOC emission reduction, in particular Directive 1999/13/EC, regulating VOC emissions from certain activities using solvents, and Directive 1994/63/EC, regulating VOC emissions from storage and distribution of petrol.

VOC emission reduction is a major objective of the Commission's "Thematic Strategy on Air Pollution" [COM, 2005] to prevent the formation of ground-level ozone. Ozone is formed through the reaction of VOC and nitrogen oxides in the presence of sunlight. In relation to health, ground level ozone and particulate matter are considered as air pollutants of most concern in Europe.[2,3] Besides health impacts, ozone contributes to global warming, and is also harmful to vegetation and material.

Considerable VOC reduction has been achieved in Europe based on the UN-ECE Gothenburg protocol (1999) and the NEC Directive 2001/81/EC, setting national emission ceilings for 2010. The ceilings for VOC are expected to be met by most Member States.[4] This will help to attain the current interim air quality targets for ozone, requiring for the protection of human health not to exceed a daily maximum of 120 µg/m^3 (8-hours mean) on more than 25 days (3-years average) from 2010 on[5]. Nevertheless, further VOC (and NOx) reduction is necessary to reduce health risks and damage of vegetation from peak ozone concentrations, and to reach the long term aim of ozone levels recommended by WHO (no exceedance of 100 µg/m^3 as daily maximum 8-hours mean)[6].

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[1] Directive 2004/42/EC of the European Parliament and of the Council of 21 April 2004 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC

[2] see European Environmental Agency information: http://www.eea.europa.eu/themes/air/about-air-pollution

[3] see WHO report on ozone health risks: http://www.euro.who.int/Document/E91843.pdf

[4] see NEC Directive status report 2007, EEA, 2008a, http://www.eea.europa.eu/publications/technical_report_2008_9

[5] Directive 2002/3/EC of the European Parliament and of the Council of 12 February 2002 relating to ozone in ambient air

[6] see WHO air quality guideline, update 2005: http://www.who.int/phe/health_topics/outdoorair_aqg/en/

On this background, and following article 9 of Directive 2004/42/EC, the project team has examinated the VOC reduction potential of products outside of the current scope of the directive, and the potential to introduce stricter VOC limit values for vehicle refinishing products. Furthermore, current VOC limit values for decorative paints have been assessed. Additionally, the project consortium has evaluated the first period of implementation of the directive, assessing problems and proposing solutions for improvement of the directive.

Methodology

Research for this report was conducted between January 2008 and June 2009, in two phases:

1. Information collection on implementation problems, evaluation of options for scope extension, preparation of related VOC data collection

2. Impact assessment of options for amendment of the directive and development of related VOC emission scenarios in Europe, additional information collection for products with VOC reduction potential

The project team consulted Member States and stakeholders (paint producers and users) 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 was compiled on products covered by the current scope and products potentially covered in future. Data was collected from stakeholders and literature research, comprising sales amounts and related VOC contents. For all products, a data base for VOC emissions in 2007 was elaborated for all 27 European Member States, and also for Croatia and Turkey. For products under the current scope and for potential changes of the directive, future projections of VOC emissions for 2010, 2015 and 2020 were developed for EU-27, Croatia and Turkey. Scenarios without changes of the directive were calculated ("business-as-usual" = BAU) and compared with scenarios resulting from the potential adoption of different options for amendment of the directive (DECO-PAINT-NEW). The complete data set can be found in annexes 19, 20 and 21.

Consultation on implementation

The product requirements of Directive 2004/42/EC came into force by 1.1.2007, but a one year transition period was given by Article 3, allowing non-compliant products to be placed on the market if shown to be produced before 1.1.2007. Therefore, when consulting stakeholders and Member States in 2008, experience with implementation and monitoring was based on a short time period.

Results of the consultation on implementation problems are presented in chapter 3 (page 53) as well as proposed solutions. Chapter 3.4 (page 75) contains an evaluation of a limited number of exemplary Member States monitoring programmes, provided voluntarily to the European Commission together with regular reporting on the directive in July 2008.

Evaluation of Member States' monitoring

Relevant information on implementation problems and on monitoring experience was received from the first regular reporting[7] on Directive 2004/42/EC to the Commission, sent by Member States in July 2008. Member States have voluntarily delivered several monitoring programmes that have been evaluated.

It has been evaluated whether the Member States' programmes are complete, effective and clear (chapter 3.4 on page 75 and annex 22 on page A-283). Proposals have been made for establishing a systematic, unambiguous monitoring programme with three levels of ambition (annex **Fehler! Verweisquelle konnte nicht gefunden werden.** on page A-**Fehler! Textmarke nicht definiert.**).

General feedback on implementation

In general, Directive 2004/42/EC was considered as successful by stakeholders and Member States. Problems with the VOC limits of phase I (starting 1.1.2007) have not been reported. CEPE stressed the level playing field created by the directive and the substantial VOC reduction achieved and expected after 2010.

In the late 1990s, CEPE estimated the percentage of water-based decorative paints in EU-15 to be ‘over 70%’, in 2003 the share was estimated at ~82 %. Reflecting the VOC limit values of phase I, CEPE estimated a share of ~85 % for 2007, based on limited data from EU-15 and some new Member States.

On the other hand paint producers and users stressed that the 18 new VOC limits introduced by 1.1.2010 are demanding. It was considered as too early for evaluating quality and performance of these products as their use has not been wide-spread yet, besides new products currently under development.

Implementation problems

Chapter 3 on page 53 describes implementation problems. Most implementation problems originate from ambiguous definitions of the scope of the directive, provoking discussions e.g. on the inclusion of bridges or subway stations regarded as buildings or on built-in kitchens and built-in wardrobes regarded as fittings of buildings, or uncertainty whether refinishing products have to comply with the directive when they are used for original coating or for repair coating of trailers and motorcycles.

Problems also arise from the overlap of Directive 2004/42/EC with Directive 1999/13/EC (regulating VOC emissions from certain activities using organic solvents). One problem results from different interpretations of the exemption clause in Article 3(2) of Directive 2004/42/EC (allowing the use of non-complying products in certain installations), in particular for cases where national

[7] according to article 7 of the directive, requiring feedback based on a Commission's questionnaire (COM 2007/205/EC)

threshold values have been set lower than thresholds of Directive 1999/13/EC. The other problem arises in installations where more than one activity is carried out, one covered by Directive 2004/42/EC, e.g. vehicle repair, and others not, e.g. trailer coating (multi-activity case).

Other difficulties arise from the analytical methods allowed by Directive 2004/42/EC. Finally, unexpected socio-economic impacts were identified.

Assessment of problems due to unexpected socio-economic impacts

Chapter 3.2 describes new socio-economic impacts, not predicted in the studies elaborated between 1999 and 2002 for preparation of Directive 2004/42/EC [Van Broekhuizen et al., 2000] [Ritchie et al., 2002] [EC, 2002].

One such impact comprises costs for take-back and destruction of non-compliant products. CEPE, representing European paint manufacturers, estimated these costs at 141 MM€.

For future cost reduction, CEPE proposed an extension of the transition time allowing sales of non-compliant products. The project team considers a period of at least 2 years after adoption of the directive as sufficient time for the sale of slow moving stocks, if combined with another year of transition allowing placing on the market of non-compliant products proved to be produced before.

Such a period generally matches with sustained trends for "just-in-time" production and delivery. A longer transition may be allowed in situations of predictable, long-lasting periods characterised by a relevant decline of economic activity.

Another impact reported by CEPE, which was not predicted by previous studies were the considerable labelling costs. CEPE estimated costs of ~576 MM€ resulting from implementation of Directive 2004/42/EC for the design, production and application of stickers to new products and to existing stocks, and another 22.5 MM€ for generation and dissemination of modified data sheets.

The project team acknowledges that labelling is related with significant costs. In the future, costs could be minimised by bringing legal requirements for labelling to a harmonised timeline at EU level. Therefore, the project team proposes to implement the amendments of Directive 2004/42/EC regarding new VOC limit values or new product categorisation e.g. by 1.6.2015, in line with changes due to the Regulation on Classification, Labelling and Packaging (2008/1272/EC).

Proposals to tackle problems arising from the overlap with Directive 1999/13/EC

The two main overlap problems (solvent consumption threshold case, multiple-activities case) have been described and evaluated in chapter 3.3 (page 55). Four options for each of the two overlap problems have been assessed with their pros and cons.

The following options have been discussed to reduce the problems resulting from different interpretations of the exemption clause in Article 3(2) of Directive 2004/42/EC (solvent consumption threshold case):

- Option A reflects the current Commission answer to frequently asked questions, indicating that the exemption also applies in case of installations with a solvent consumption below the relevant threshold of Annex IIA, but authorised/registered according to national law and operated in line with the provisions of Articles 3 and 4 of Directive 1999/13/EC.

- Option B is a strict interpretation of the wording of Article 3(2), hence coatings shall only be exempted from the requirements of Directive 2004/42/EC if they are used for activities actually operating above the thresholds set out in Annex IIA of Directive 1999/13/EC and which are registered/authorised and operated in line with the provisions of Articles 3 and 4 of Directive 1999/13/EC.

- Option C suggests the introduction of a certificate for registered/authorised installations according to Articles 3 and 4 of Directive 1999/13/EC as a pre-condition to purchase products exempted from compliance with Directive 2004/42/EC to enhancing the correct use of products exempted from compliance with Directive 2004/42/EC.

- Option D proposes an amendment of Directive 2004/42/EC to extend the exemption of Article 3(2) to all activities under Annex I of Directive 1999/13/EC regardless whether they provide of a registration/authorisation or whether they are operated in line with the provisions of Articles 3 and 4 of Directive 1999/13/EC. Under this option, Directive 2004/42/EC would cover only products used outside of installations ("in-situ").

The following options have been discussed to reduce problems resulting from potential incorrect use of products where several activities are realised in one installation (multiple activities case):

- Option A proposes an extension of the scope of Directive 2004/42/EC to coatings used for other objects than currently under the scope.

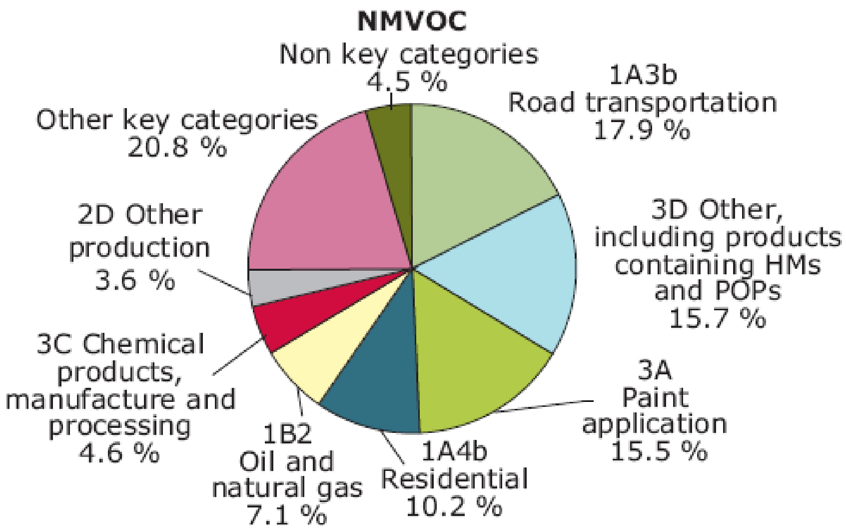
- Option B suggests the introduction of labelling provisions, stating the objects each coating is made for.

- Option C recommends monitoring of the correct use of products under the scope of Directive 2004/42/EC inside of installations.

- Option D proposes an amendment of Directive 1999/13/EC by explicitly stating that both trailer coating activities are covered by Directive 1999/13/EC: original coating of trailers and repair coating of trailers.

Selection of options for potential amendment of Directive 2004/42/EC

During the first project phase, information has been collected and assessed on products groups with VOC reduction potential, aiming at proposals for options to be agreed with the Commission and further assessed in the second project phase. Figure 1 shows emissions of NMVOC from different categories of use.



[EEA, 2008a]

Figure 1: Contribution of key categories to EU-27 emissions of non-methan VOC in 2006

Solvent used for open application under 'uncontrolled' condicions is mainly included in the categories 3A 'Paints' and '3D 'Other'. When selecting the options, it was considered whether the product group has a relevant share within the category and/or technical possibilities for VOC reduction are easy to achieve. Additionally, product groups have been taken up when they ease the regulation, leading to less ambiguous scope or product definitions.

17 options were selected and agreed with the Commission for further assessment (see Table 1 below). An extensive impact assessment, involving consultation of stakeholders and Member States was realised for 10 options (for quantified benefits see Table 2).

Other options have been assessed already in the first project phase, like evaluation of an inclusion of aerosol-type decorative paints, feasibility of stricter limits for decorative paints and of stricter limits for vehicle refinishing products.

Assessment of inclusion of aerosol decorative paints

The total VOC emissions in EU-27 from aerosol paints has been estimated by CEPE with 19.7 kt in 2007, equivalent to 1.4 % of the total VOC emission from paints (classified as category 3A, 1459 kt in 2006 [EEA, 2008a]).

The assessment of a potential scope extension covering so called 'non-automotive' aerosol-type coatings has come to the conclusion that this product group should not be considered for inclusion into the scope of Directive 2004/42/EC (see chapter 4.4, page 88). The product group comprises a high variety of product types for different purposes (> 40), making the definition of ambitious and appropriate VOC limits difficult and resulting in complex monitoring. Furthermore, the VOC reduction potential is expected to be small due to the limited availability of systems for VOC reduction (max. 1.9 kt/a). A phase out of the product group is considered as unappropriate because the maximum VOC emission reduction is about 21.1 kt in 2010 and 25.5 kt in 2020. Alternative coating systems using brush or roller application are expected to go along with loss of product performance. If aerosol systems with compressed-air are available in future, the VOC reduction potential should be assessed again.

Stricter VOC limit values under the current scope

After assessment of technical possibilities (chapter 4.3), stricter VOC limit values for vehicle coatings have not been proposed.

For decorative coatings, stricter VOC limit values will come in force by 1.1.2010; nevertheless there have been indications for the possibility to reduce the new limits, in particular when compared to the 100 g/l VOC limit value for *interior* paints enforced in The Netherlands. Therefore, under option 4, an inclusion of separate VOC limit values for interior use has been assessed (chapter 4.2).

Re-classification of product groups and inclusion of products (Options 2, 3)

Options 2 adapts VOC limit of topcoats to the state of the art and option 3 follows a proposal of CEPE to reduce VOC limits for certain vehicle refinishing products to prevent misclassification, and to newly take up plastic adhesion promoters, tyre paints and rim silver paints into the scope as 'special coatings' within the product group with the highest VOC content of 840 g/l.

The total VOC emissions in EU-27 from these vehicle refinishing products has been estimated based on CEPE data with 8.6 kt in 2015, equivalent to 0.5 % of the total VOC emission from paints (category 3A, 1459 kt in 2006). [EEA, 2008a]

It is proposed to take up the proposal despite an increased monitoring effort and a potential for confusion because of the changed VOC limit values.

Options assessed for potential amendment of Directive 2004/42/EC

The following options have been selected by the project team and agreed with the Commission for further assessment in the second project phase.

Table 1: Overview on options for further assessment resulting from the first project phase

Option (number and short title)	Activity in second project phase	More information to be found
1 Improvement of definitions	Information collection	Chapter 8, p. 239
2 New VOC limit within an existing vehicle refinishing group	Impact Assessment	Annex 4, p.41
3 New allocation of vehicle refinishing product groups		
4 New VOC limit values for interior use of decorative paints in categories d), e) and f)	Impact Assessment	Annex 5, p. 55
5 Update of ISO test method	Information collection	Chapter 8, p. 114
6 Inclusion of additional ISO test method	Information collection	
7 Inclusion of measuring method description	Information collection	
8 Extension of the scope covering coatings for all wooden objects	Impact assessment	Chapter 11, p. 128; Annex 7, p. 79
9 Extension of the scope covering protective coatings	Impact assessment	Chapter 12, p. 134; Annex 6, p. 73
10 Extension of the scope covering motorcycle coatings	Information collection	Chapter 10, p. 126
11 Extension of the scope covering solvent-based floor covering adhesives	Impact assessment	Chapter 13, p. 143; Annex 12, p. 135
12 Extension of the scope covering cosmetic products a) deodorants/antiperspirants, b) hairsprays, c) labelling of VOC content of deodorants/antiperspirants and hairsprays	Impact assessment	Chapter 14, p. 151; Chapter 15, p. 162; Chapter 16, p. 169; Annex 13, p. 151
13 Extension of the scope covering glass window cleaners	Impact assessment	Chapter 17, p. 174; Annex 16, p. 221
14 Extension of the scope covering aerosol-type insecticides	Information collection	Chapter 18, p. 180
15 Extension of the scope covering marine coatings	Information collection	Chapter 19, p. 184
16 Extension of the scope covering road markings	Information collection	Chapter 20, p. 187
17 Extension of the scope covering impregnating products	Information collection	Chapter 21, p. 191

Evaluation of improvement options for Directive 2004/42/EC (Options 1, 4, 5, 6, 7)

Several options of the below list of options aim at better regulation, intending an improvement of Directive 2004/42/EC by creating a level playing field in the European Union through similar interpretation of wording and related consistant enforcement. These options are listed as number 1, 4, 5, 6 and 7. It is recommended to take up all results elaborated under these options under the next review of Directive 2004/42/EC. For details see chapter 5 on page 95.

Proposal to reduce problems related to the scope definitions (Option 1)

To solve problems arising from scope definitions, the project team proposes:

- Insert a new wording of annex I (1), to achieve unambiguous definition of the current scope of decorative coatings, defining the term "building" adapted from an ISO standard definition from the building sector, deleting the terms "trims" and "fittings" (regarded as superfluous).

- Insert a new wording of annex I (1), to achieve unambiguous definition of the current scope of decorative coatings, defining that any furniture is not covered by the current scope of Directive 2004/42/EC (neither when fixed). This clarification shall be combined with a definition of furniture.

- Insert a new wording of annex I (2), to achieve unambiguous definition of the current scope of vehicle refinishing coatings, clarifying that refinishing of motorcycles and trailers are covered by the scope of the directive (at present not covered because they are not covered by the "vehicle" definition in the regulation Directive 2004/42/EC refers to).

- Update the link in annex I (2) of Directive 2004/42/EC for definition of "vehicles" to the new version of the directive: Directive 2007/46/EC.

For analysis of problems with scope definitions see annex 3.1 (p. A-24).

Proposals to improve the analysis methods (Options 5, 6, 7)

To avoid problems with the analytical methods, the project team proposes to

- Update annex III test method for determination of the VOC content (currently ISO 11890-2:2002), using ISO 11890-2:2007.

- Include in annex III the less cost intensive method ISO 11890-1:2007, recommended by ISO 11890-2:2007 for low VOC content analysis.

- Insert a new annex as annex IV to provide an additional description of the method for measuring film thickness of wood stains, inserting a reference to this description in annex I under number 1.1 f) accordingly.

For details of problems arising from analytical methods see annex 3.2 (p.A-27).

Information collection on motorcycling coatings (Options 10)

It is recommended to extend formally the scope of Directive 2004/42/EC by inclusion of motorcycling coatings because vehicle refinishing products are used, and non-inclusion may lead to mis-use of products classified for motorcyclings and used for road vehicle coatings. Clear defined and limited exceptional integration of some products in category e) (high VOC content of 840 g/l) may be granted for certain colored varnishes (see chapter 10 on page 126).

Information collection on aerosol-type insecticides (Options 14)

Regarding the extension of the scope to aerosol-type insecticides, information for a complete impact assessment could not been collected. Therefore it is proposed to assess the technical VOC emission reduction options and related impacts more deeply in a future revision (see chapter 18 on page 180).

The total VOC emissions in EU-27 from insecticides has been estimated with 5 kt in 2007, based on data of A.I.S.E., equivalent to 0.3 % of the total VOC emission from 'Others' (category 3D, 1473 kt in 2006). [EEA, 2008a]

Results of the impact assessment for 10 options

Table 2: Description of impact assessment options with resulting costs and benefits (human health/field crops)

Option	Costs	Benefits		
		Human Health		
		Reduced Mortality YOLL (Years of Life Lost)	Total (by median 52,000 €/a)	Field crops
Option 2: New VOC limit within an existing vehicle refinishing product group	* no significant costs have been identified/ quantified * some costs of adaption might arise	2015: 5.0 YOLLs 2020: 4.7 YOLLs	2015: € 694,000 2020: € 653,000	2015: € 366,000 2020 € 344,000
Option 3: New allocation of vehicle refinishing product groups	* no significant costs have been identified/ quantified * some costs of adaption might arise	2015: 0.3 YOLLs 2020: 0.4 YOLLs	2015: € 48,000 2020: € 51,000	2015: € 26,000 2020 € 28,000
Option 4: New VOC limit values for interior use of decorative paints	Labelling: €150 per SKU (CEPE) Move to compliant products: € 1.25 million (Eastern EU company) Increase in start-up costs by 2.5 to 5% (CEPE)	2015: 37.0 YOLLs 2020: 36.0 YOLLs	2015: € 5.2 million 2020: € 5.0 million	2015: € 2.8 million 2020 € 2.7 million
Option 8: Extension of the scope covering coatings for all wooden objects	Investment in drying equipment: *€ 100,000 - 1 million (UK) * € 10,000 - 50,000 (NL) no quantification of further costs possible	* scenario a) 2015: 34.7 YOLLs	* scenario a) 2015: € 4.8 million	* scenario a) 2015: € 2.3 million
		* scenario b) 2015: 53.6 YOLLs 2020: 40.8 YOLLs	* scenario b) 2015: € 7.5 million 2020: € 5.7 million	* scenario b) 2015: € 3.5 million 2020: € 2.6 million
Option 9: Extension of the scope covering protective coatings	Increasing costs in monitoring and surveillance expected by Member States' authorities Costs of reformulation, testing, advertising and stranded assets: costs estimate received from one Member State (small producer), not considered as reliable for extrapolation	* scenario a) 2015: 0.6 YOLLs 2020: 0.2 YOLLs	* scenario a) 2015: € 90,100 2020: € 29,600	* scenario a) 2015: € 42,500 2020: € 14,000
		* scenario b) 2015: 4.8 YOLLs 2020: 3.9 YOLLs	* scenario b) 2015: € 666,000 2020: € 547,000	* scenario b) 2015: € 316,700 2020: € 258,100
		* scenario c) 2020: 13.7 YOLLs	* scenario c) 2020: € 1.9 million	* scenario c) 2020: € 901,700
		* scenario d) 2020: 17.4 YOLLs	* scenario d) 2020: € 2.4 million	* scenario d) 2020: € 1.1 million
For methodological details see Annex 18, page 245				

Option	Costs	Benefits: Human Health – Reduced Mortality (Years of Life Lost)	Benefits: Human Health – Total (by median 52,000 €/a)	Benefits: Field crops
Option 11: Extension of the scope covering solvent-based floor covering adhesives	no costs could be quantified high national differences assumed (low costs in Germany, high costs in UK)	2015: 32.0 YOLLs 2020: 30.7 YOLLs	2015: € 4.5 million 2020: € 4.3 million	2015: € 2.0 million 2020 € 2.0 million
Option 12 a): Extension of the scope covering cosmetic products a) deodorants/ antiperspirants	Reduction in tax revenue: € 200-250 million (FEA/Colipa) Capital investment: € 120-150 million (FEA/Colipa) Stranded assets: € 250-300 million high impacts on competitiveness employment assumed by FEA/Colipa	* scenario a) 2015: 203.2 YOLLs 2020: 205.7 YOLLs	* scenario a) 2015: € 28.4 million 2020: € 28.8 million	* scenario a) 2015: € 14.6 million 2020: € 14.9 million
		* scenario b) 2015: 195.1 YOLLs 2020: 197.6 YOLLs	* scenario b) 2015: € 27.3 million 2020: € 27.6 million	* scenario b) 2015: € 14.0 million 2020: € 14.3 million
Option 12 b): Extension of the scope covering cosmetic products b) hairsprays	Cost of reformulation: Low (single producers) up to € 1 million per brand (FEA / Colipa) potential for re-location of production outside EU due to performance changes (FEA/Colipa)	2015: 7.6 YOLLs 2020: 7.7 YOLLs	2015: € 1.1 million 2020: € 1.1 million	2015: € 548,000 2020: € 556,000
Option 12 c): Extension of the scope covering cosmetic products c) compulsory labelling of products	labelling: may be negligible (FEA / Colipa) costs would arise for artwork development, measurement and production of labels in different languages (FEA / Colipa) one-off costs of labelling: € 500 – 1000 per product (PZPK)	* scenario a) 2015: 13.7 YOLLs 2020: 13.9 YOLLs	* scenario a) 2015: € 1.9 million 2020: € 1.9 million	* scenario a) 2015: € 990,000 2020: € 1.0 million
		* scenario b) 2015: 27.5 YOLLs 2020: 27.9 YOLLs	* scenario b) 2015: € 3.8 million 2020: € 3.9 million	* scenario b) 2015: € 1.9 million 2020: € 2.0 million
		* scenario c) 2015: 41.2 YOLLs 2020: 41.8 YOLLs	* scenario c) 2015: € 5.8 million 2020: € 5.8 million	* scenario c) 2015: € 2.9 million 2020: € 3.0 million
		* scenario d) 2015: 55.0 YOLLs 2020: 55.7 YOLLs	* scenario d) 2015: € 7.7 million 2020: € 7.8 million	* scenario d) 2015: € 3.9 million 2020: € 4.0 million
For methodological details see Annex 18, page 245				

Option	Costs	Benefits		
		Human Health		Field crops
		Reduced Mortality (Years of Life Lost)	Total (by median 52,000 €/a)	
Option 13: Extension of the scope covering glass and window cleaners	no costs quantifiable for testing and investment in re-formulation of products	* scenario a) 2015: 4.0 YOLLs 2020: 4.0 YOLLs	* scenario a) 2015: € 554,000 2020: € 561,000	* scenario a) 2015: €267,000 2020: € 271,000
		* scenario b) 2015: 8.4 YOLLs 2020: 8.5 YOLLs	* scenario b) 2015: € 1.2 million 2020: € 1.2 million	*scenario b) 2015: € 569,000 2020: € 577,000
For methodological details see Annex 18, page 245				

Conclusion of impact assessments and amendment proposals

Based on the impact assessments resulting in the figures above, it is recommended to include the following product groups into the scope of the directive, listed in the order of priority (category 3A 'Paints': 1459 kt / category 3D: 1473 kt VOC in 2006 in EU-27 [EEA, 2008a]):

1. **Option 12 c): Hairsprays and deodorants/antiperspirants** => inclusion of the product group requiring labelling of the VOC content, resulting in **~9 - 39 kt VOC reduction**, equivalent with **~0.6 - 2 %** VOC emissions of 'Others solvents' (category 3D).

2. **Option 12 b): Hairspray** => inclusion and determination of a 90 % VOC limit value, resulting in **~5 kt VOC reduction**, equivalent with **~0.4 %** VOC emissions of 'Others solvents' (category 3D).

3. **Option 11: Solvent-based adhesives** => inclusion and requirement of complete substitution, resulting in **~20 kt VOC reduction**, equivalent with **~1.4 %** VOC emissions of 'Others solvents' (category 3D).

4. **Option 13: Window cleaners** => inclusion and determination of a 5 % VOC limit value, resulting in **~5.5 kt VOC reduction**, equivalent with **~0.4 %** VOC emissions of 'Others solvents' (category 3D).

5. **Option 9: Protective coatings** => inclusion and determination of the VOC limit values proposed by CEPE, resulting in **~0.1 - 12 kt VOC reduction**, equivalent with **~0 - 0.8 %** VOC emissions of 'Paints' (cat. 3A)

6. **Option 4: Interior decorative paints** => determination of new VOC limit values of 130 g/l, resulting in **~25 kt VOC reduction**, equivalent with **~1.7 %** VOC emissions of 'Paints' (category 3A).

7. **Option 8: Wood coatings** => inclusion and determination of a VOC limit value of 300 g/l, resulting in **~26 kt VOC reduction**, equivalent with **~1.8 %** VOC emissions of 'Paints' (category 3A).

8. **Option 2+3: New product groups for vehicle refinishing** => inclusion/ re-categorisation, resulting in **~3.5 kt VOC reduction**, equivalent with **~0.2 %** VOC emissions of 'Paints' (category 3A).

Option 12 a: Deodorants/antiperspirants => introduction of a VOC limit value of 10 %, resulting in **126 kt VOC reduction**, equivalent with **8.6 %** VOC emission of 'Other solvents'. This option would lead to the highest VOC reduction of all options. It would double the effect of all other options. However, it is not recommended for take-up in Directive 2004/42/EC because the implementation of the option is expected to have limited acceptance at consumers used to apply aerosol- or pump-type spray systems. They would need to change to roller-type deodorants/antiperspirants because other low-/no-VOC systems do not exist. Sticks would have to be substituted as well, although the shift from stick-users to roll-on users is not regarded as difficult.

The following figure shows the maximum VOC reduction potentials of all options.

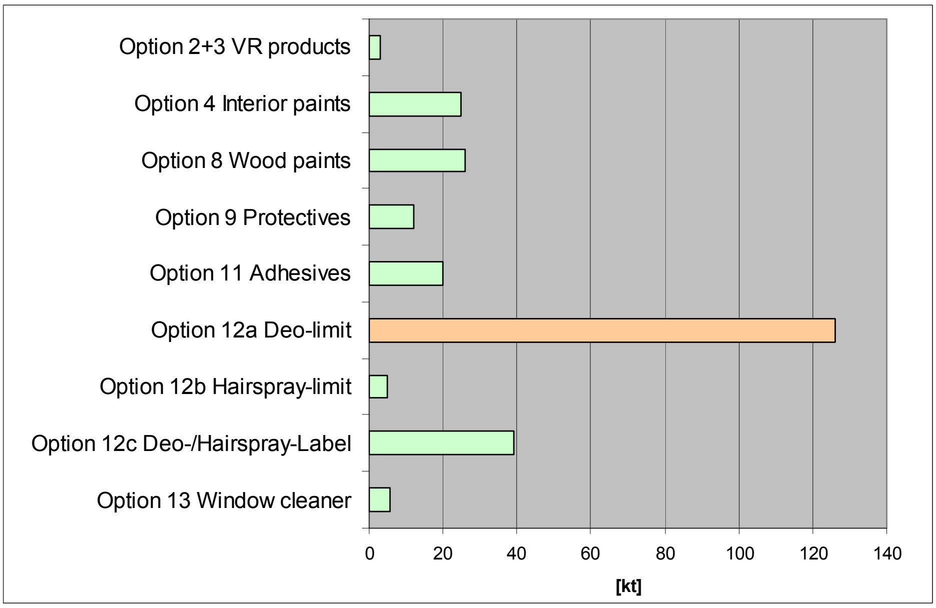


Figure 2: Maximum VOC reduction in 2020 when implementing the options assessed

It is recommended to support research and development for alternative spraying systems for deodorants. This could also have a significant effect on hairspray (in the same magnitude as Option 12a) if substitution of solvent aerosol hairsprays can be substituted with non-VOC or low-VOC systems. First developments are currently being made (see annex 13.1.3 on page 158).

Other assessments

Data collection on road markings was difficult and did not provide sufficient information on time for an impact assessment. However, there are clear indications of a relevant reduction potential (see chapter 20, p. 187, and annex 17).

CONTENT

TABLES

FIGURES

Glossary of terms

AEROBAL – International Organisation of Aluminium Aerosol Container Manufacturers

AVNH – Association of Paint Manufacturers of the Czech Republic

AIRC - Association Internationale des Réparateurs en Carrosserie

A.I.S.E. - Association for Soaps, Detergents and Maintenance Products

ASC - The Adhesive and Sealant Council

BASA – British Adhesives and Sealants Association

BAU – Business as usual

CAFE - The Clean Air for Europe Programme

CAGR – Compound Annual Growth Rate

CECRA - European Council for Motor Trades and Repairs

CEFIC – European Chemical Industry Council

CES – Centre Européen des Silicones (CEFIC sector group)

CEPE - European Council of the Paint, Printing Ink and Artists‘ Colours Industry

CEPMC - Council of European Producers of Materials for Construction

CLRTAP – Convention on Long Range Transboundary Air Pollution

Colipa - European Cosmetic, Toiletry and Perfumery Association

EC - European Commission

EMEP - European Monitoring and Evaluation Programme (of CLRTAP)

ESIG - European Solvents Industry Group

EURMIG - European Union Recreational Marine Industry Group

EuroStat - Statistical Office of the European Communities, Luxembourg

ExternE - Externalities of Energy (EC research project series)

FEA - European Aerosol Federation

FEICA - Association of European Adhesives and Sealants Manufacturers

GDP - Gross Domestic Product

IIASA - International Institute for Applied Systems Analysis

IVK – Industrieverband Klebstoff (German Adhesives Association)

MTFR – Maximum Technical Feasible Reduction

NECD, NEC Directive - Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants

NEEDS - New Energy Externalities Development for Sustainability

SPP – Polish Floor Layers Association

sku – stock keeping unit

UNIEP - The International Association of Painting Contractors

UEA - Union Européenne de l'Ameublement

VOLY - Value of a life year

YOLL – Years of Life Lost

WHO – World Health Organisation

w/w – weight per weight

ZVPF – Zentralverband Parkett und Fußbodentechnik (German Parquet and Flooring Technique Association)

1. Introduction

This report was elaborated in the context of a contract between the Commission and a project consortium lead by Ökopol, signed on 21st December 2007 and lasting until 21st June 2009. The project aims are:

- Providing technical services to the Commission for the preparation of the Directive 2004/42/EC review and the report for the Parliament and the Council;
- Analysing in depth the first year of application of Directive 2004/42/EC, making recommendations to improve its implementation.

1.1. Project context: Directive 2004/42/EC and other policies to reduce air pollution

In 2004 the European Parliament and the Council passed Directive 2004/42/EC ('Decopaint Directive') limiting the emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes, as well as in vehicle refinishing products, and amending Directive 1999/13/EC. VOC limit values of Directive 2004/42/EC are shown in Figure 3 for decorative paints and in Figure 4 for vehicle refinishing products.

Article 9 ('Review') of Directive 2004/42/EC invites the Commission to submit to the Parliament and the Council a report with amendment proposals, if appropriate, based on the results of the review of the Directive on National Emission Ceilings for certain atmospheric pollutants (NEC Directive)[8]:

- examining a further VOC reduction by extending the scope of Directive 2004/42/EC including aerosols for paints and varnishes;
- examining the introduction of a further VOC reduction (phase II) of vehicle refinishing products in Directive 2004/42/EC; and
- examining any new element relating to the socio-economic impact of the application of phase II, foreseen by the Directive 2004/42/EC for paints and varnishes.

Directive 2004/42/EC Article 6 ('Monitoring') requires that Member States set up a monitoring programme to verify compliance. Article 7 ('Reporting') foresees that Member States report before July 2008 to the Commission on the results of the monitoring programme using a common format, published after the Commission decision of 22 March 2007 (2007/205/EC).

[8] The NEC Directive review may fix new national emission ceilings for VOC emissions, corresponding to the 2020 objectives of the Thematic Strategy on Air Pollution

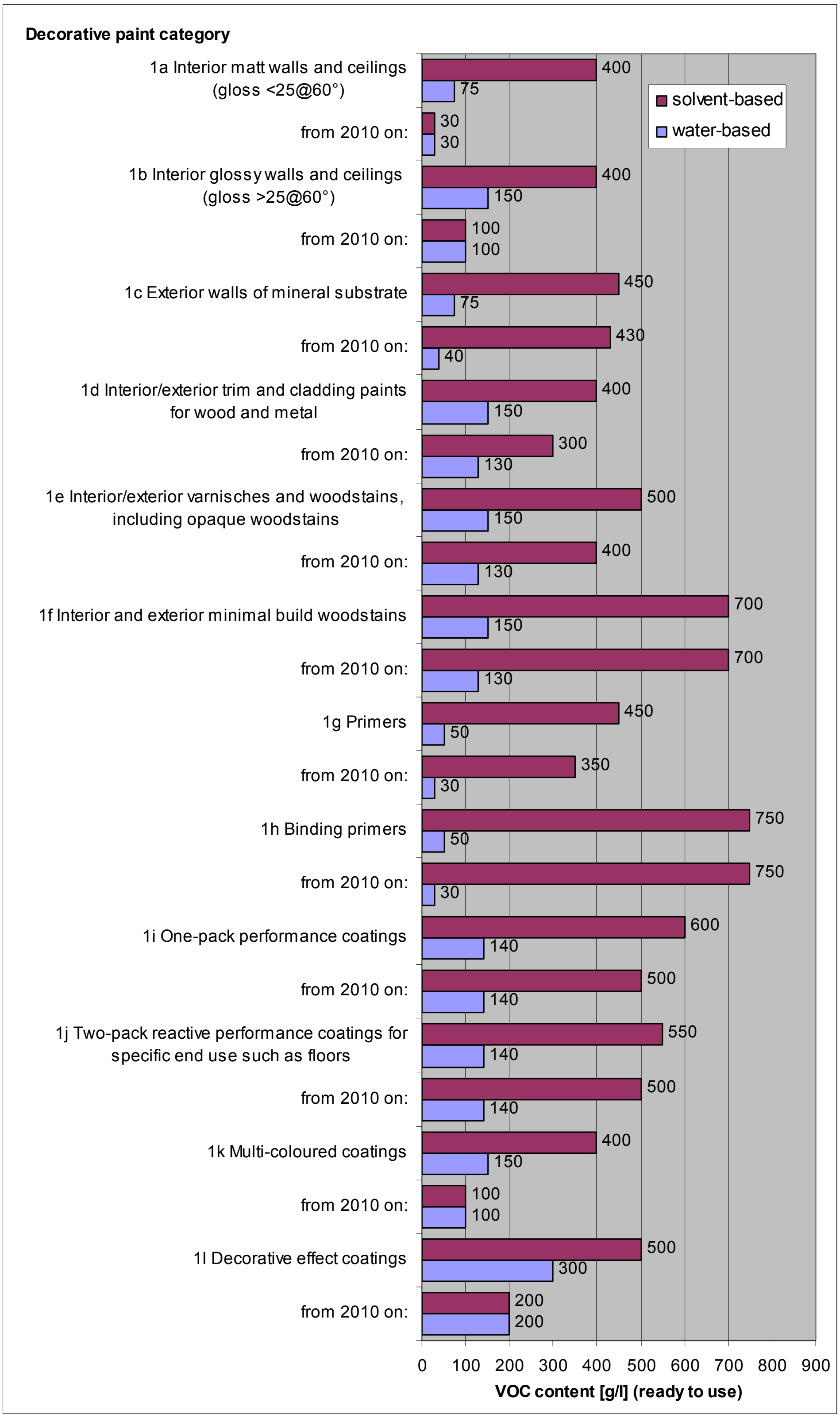


Figure 3: VOC limit values for decorative paints from 1.1.2007 on (phase I) and from 1.1.2010 on (phase II)

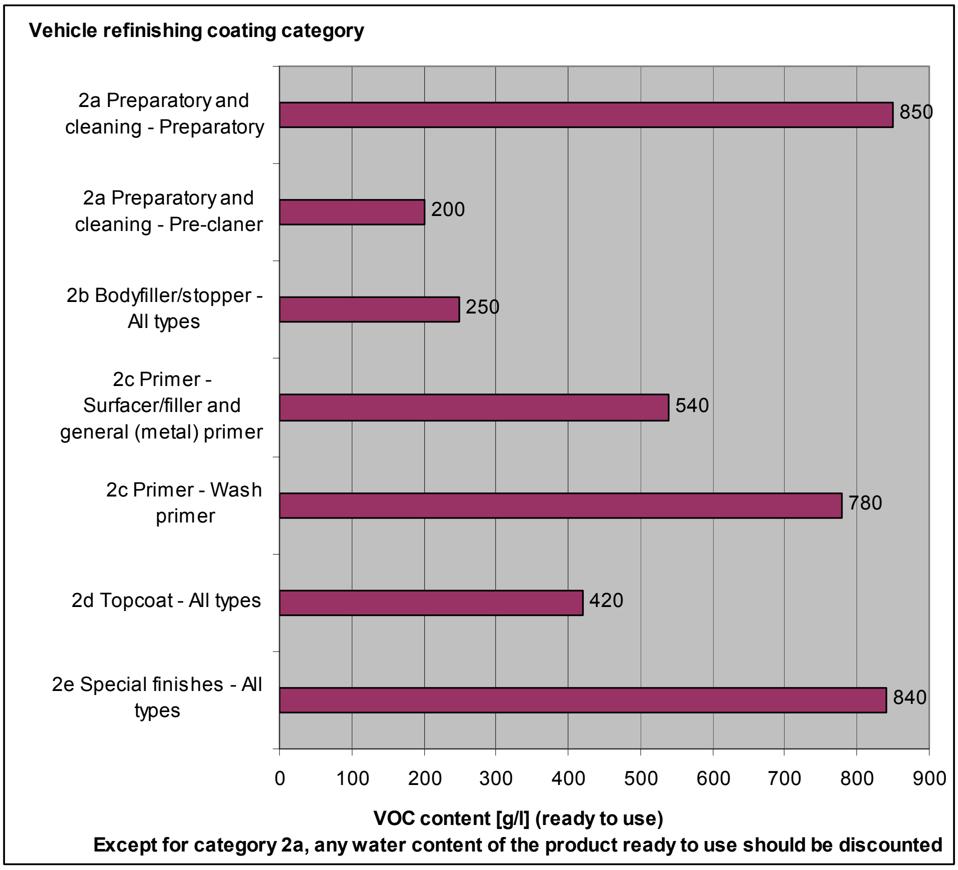


Figure 4: VOC limit values for vehicle refinishing coatings from 1.1.2007 on

Before project initiation the Commission indicated to the contractor that some implementation problems had already been reported by stakeholders and that these would need further clarification. These problems were principally related to the application of Directive 2004/42/EC annex III (analytical methods) and to Article 3.2 (derogation for installations covered by Directive 1999/13/EC).

During the kick-off meeting on 14 January 2008, the Commission informed the contractor that it was agreed with the Parliament to postpone the Commission's report on Directive 2004/42/EC to the end of 2009 (initially intended for 2008).

In October 2008 the Commission informed the contractor that the Commission's proposal for revision of the NEC Directive was expected to be published not before end of 2009. Accordingly it would not be published during the contracted project time. Therefore it was not possible in this study to refer to a Commission's proposal for VOC emission ceilings for 2020.

However, in the context of the revision of the NEC Directive, IIASA published a report for the Commission in July 2008 proposing national emission ceilings for 2020 [IIASA 2008]. The main scenarios of the IIASA report are based on the measures of the Commission's Climate & Energy Package [COM, 2008] and on the aims of the Commission's Thematic Strategy on Air Pollution [COM, 2005].

The Commission's Climate & Energy Package was developed to reduce CO_2 emissions from energy systems. The measures of the package shall lead, among others, to a reduction of VOC emissions, for example from reduced use of fuel for transport. The Commission's Thematic Strategy on Air Pollution aims among others at a reduction of 51% VOC emissions and 60% NOx emissions in EU-27 until 2020 to achieve a reduction of ground level ozone concentration by 60%. By this, acute mortalities (premature deaths) from exposure to ozone shall be reduced from 20,294 cases in 2000 to 18,265 cases in 2020.

Against the background of the Commission's Climate & Energy Package, the IIASA study estimates that VOC emissions in EU-27 could be reduced from 10,867 kt in 2000 to 6,146 kt in 2020 under the following conditions:

- All current emission control legislation is fully implemented.[9]
- All Member States meet the 2010 National Emission Ceilings for VOC.[10]
- The Commission's proposal for EURO-VI standards for heavy duty vehicles is accepted [COM, 2007a].[11]
- The Commission's proposal for an Industry Emissions Directive is accepted, in particular regarding strict emission limit values for large combustion plants [COM, 2007b].[12]

According to IIASA, a 'baseline' scenario complying with the conditions described above will not achieve the targets of the Commission's Thematic Strategy on Air Pollution in 2020. IIASA has used the GAINS model optimization to identify the set of least-cost emission reduction measures meeting simultaneously all targets of the Thematic Strategy on Air Pollution ('TSAP' scenario). For this scenario IIASA estimates an additional reduction of 74 kt VOC until 2020, achieved with measures mainly aiming at a reduction of particulate matter (7 kt VOC reduction by improved/new stoves and boilers in the domestic energy use sector, 67 kt VOC reduction by strict enforcement of ban on open burning of agricultural residues, mostly in the New Member States). [IIASA 2008]

Furthermore, IIASA has developed a scenario providing additional emission reduction ('EP scenario') because the targets of the Commission's Thematic Strategy on Air Pollution were critisized in a resolution of the European Parliament, argueing that "*the Strategy does not show how the objectives of the 6th Environment Action Programme can be attained; therefore calls for the Commission to aim for a significantly higher level of ambition to reduce air pollution for 2020 in order to attain those objectives*". [EP, 2006]

For the 'EP scenario', additional reduction of 17% NOx emissions and 5% VOC emissions is necessary. The VOC reduction equals 549 kt, whereof IIASA esti-

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[9] See IIASA report Tables 3.2. and 3.4 for relevant legislation on transport and on VOC

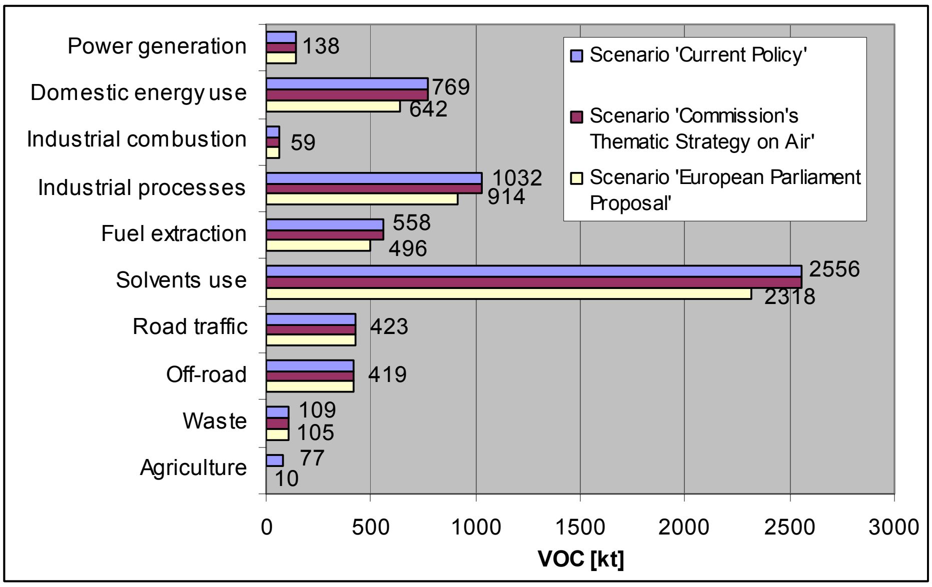
[10] The latest NEC Directive status report of December 2008 reports that five Member States indicate they will miss their NMVOC ceiling (Denmark, France, Poland, Portugal and Spain) [EEA, 2008a]

[11] The proposal was realised by Regulation 595/2009 of 18.6.2009.

[12] Weakening of the proposal for large combustion plants is discussed in 2009; the final outcome is expected in 2010.

mates that 238 kt could be obtained cost-efficiently with measures in the solvent use sector, at an estimated annual cost of 316 m€/y. [IIASA 2008, p. 56-62]

The 'EP scenario' leads to 1218 fewer cases of premature deaths attributable to ground-level ozone (20,294 cases in 2000, 17,047 in 2020), whereas the scenario 'Thematic Strategy' results in 18,265 premature deaths in 2020 (+7 %).



based on [IIASA, 2008]

Figure 5: VOC sector emissions in 2020 of three IIASA scenarios based on most cost-efficient measures

Regular reporting of the Member States to the European Environmental Agency shows that VOC emissions have been reduced by 47%, from 16.9 million tonnes in 1990 to 9 million tonnes in 2007. Despite significant reductions in all Member States but Poland, six major countries dominate by far (FR, DE, ES, IT, PL, UK), being responsible for 72 % of the total emissions in 2007, each country contributing with more than 10 million tonnes of VOC (see). [EEA, 2009]

In the context of this study, data on total NMVOC emissions from anthropogenic sources have been compiled for EU-27 and Croatia+Turkey. Table 3 shows anthropogenic NMVOC data of 2006 reported by Member States [EEA, 2008a] as well as projections for 2010 for all contributing sectors, that have been undertaken based on country specific data and stakeholder information of the IIASA report [IIASA, 2009]. NMVOC emissions have also been calculated for the sectors 'solvent use', for all 'paints' and for the paint products covered by Directive 2004/42/EC ('decorative paints', 'vehicle refinishing products'), based on CEPE data and on the report of IIASA [IIASA, 2009].

During the project, the relevance of biogenic VOC emissions for ozone formation has been mentioned by several stakeholders. National biogenic NMVOC emissions are difficult to calculate because they vary, depending on climatic conditions, seasonal effects and the type of the regional vegetation. Any summarised national data on biogenic emissions has to be interpreted on the background of these significant climatic, seasonal and regional differences.

Table 3 also includes exemplary data of biogenic NMVOC emissions from forest and other land use [Steinbrecher et at., 2008]. This data set is based on the average of the meteorological years 1997 and 2001, considered as representative meteorological years.[13] Total NMVOC emissions in EU-27 are ~20m t/a.

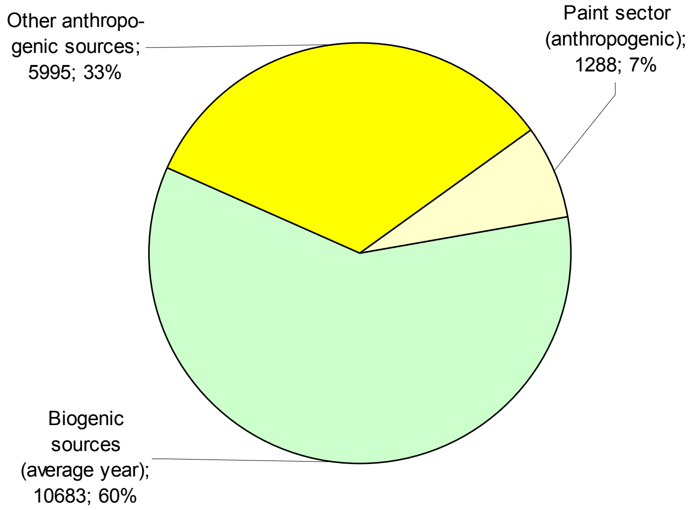
Table 3: Estimated biogenic NMVOC emissions of 1997/2001 and anthropogenic NMVOC emissions in EU-27 and Croatia+Turkey in 2006 and 2010, NMVOC in 2010 from solvent use, paints, decopaints and vehicle refinishing products

Country	Forest + other land use	All sectors	All sectors	Solvent use	Paint application	Decorative paints	Vehicle refinishing products	Decorative paints	Vehicle refinishing products
	[Steinbrecher et al., 2008]	[EEA, 2008b]	based on GAINS modelling data for [IIASA, 2008]					based on CEPE (see chapter 3.5)	
	1997/ 2001	2006	2010	2010	2010	2010	2010	2010	2010
	kt	kt	kt	kt	kt	kt	kt	kt	kt
Austria	205	168	144	67	21	2	0.3	5.2	2.0
Belgium	48	150	138	65	24	5	0.9	7.6	2.4
Bulgaria	274	159	117	33	14	2	1.9	1.5	0.2
Cyprus	61	11	7	2	0.3	0.1	0.03	8.2	*
Czech Rep.	149	172	229	87	26	6	0.4	6.5	0.7
Denmark	39	108	94	29	11	3	0.5	4.2	1.3
Estonia	81	35	28	5	1	0.5	0.06	0.8	0.08
Finland	529	132	111	38	19	4	0.4	3.3	0.7
France	1246	1345	893	336	118	51	6.3	59	7.7
Germany	640	1349	1050	699	253	69	5.5	70	12.6
Greece	602	291	177	57	31	7	0.8	11	1.0
Hungary	147	179	111	43	23	5	0.5	7.1	0.5
Ireland	41	59	56	28	7	2	0.3	4.4	0.6
Italy	908	1159	856	391	158	41	5.4	42	9.6
Latvia	123	65	56	18	10	3	0.1	0.9	0.1
Lithuania	114	78	63	15	10	3	0.3	1.4	0.2
Luxembourg	6	10	9	2	1	0.3	0.06	0.0	*
Malta	0.2	4	4	2	0.4	0.2	0.02	0.3	*
Netherland	39	166	158	79	36	12	1.5	13	4.7
Poland	554	911	422	135	63	9	4.7	31	1.7
Portugal	673	312	181	67	34	14	0.9	14	1.4
Romania	381	299	423	135	34	1	1.6	5.6	0.7
Slovenia	61	41	36	9	3	2	0.02	2.6	0.3
Slovakia	101	78	55	27	10	1	0.4	1.8	0.2
Spain	2658	928	760	404	243	51	3.6	53	7.7
Sweden	736	195	167	64	27	6	0.5	11	2.2
UK	266	910	939	298	110	30	8.4	4	7.8
EU-27	10683	9314	7283	3134	1288	349	45	370	66
Croatia	146	no data	73	20	7	2	0.6	2	0.2
Turkey	1141	no data	667	147	73	17	13.4	24	2.5
EU-27+2	11970	9314+x	8033	3301	1368	368	59	396	69
* Data included elsewhere: Cyprus in Greece, Malta in Italy, Luxembourg in Belgium									

Figure 6 shows the share of NMVOC emissions in EU-27 from biogenic sources in a reference year considered as metereologically representative (for that year: 60 % of the total emissions) as well as NMVOC emissions from anthropogenic sources calculated for 2010, based on modelling data of GAINS and EcoSense.

[13] For this reason, the average country specific NMVOC emissions of both years was chosen for the projection of country specific emissions of 2010 in the European modelling project 'NatAir' (http://natair.ier.uni-stuttgart.de).

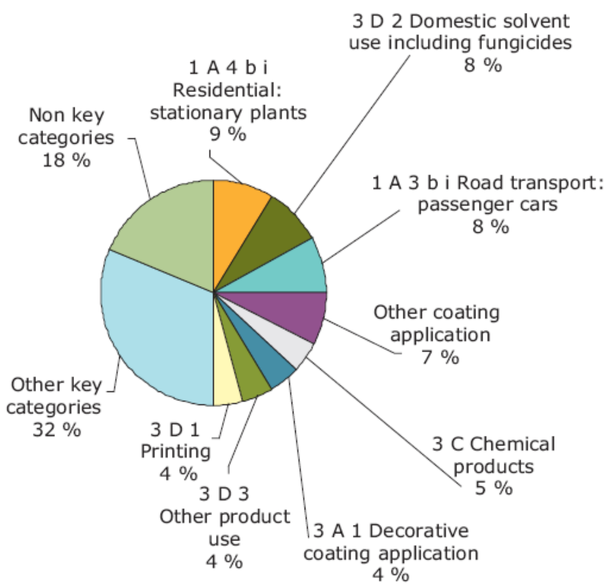
Table 3 and Figure 6 show that NMVOC emissions from the paint sector contribute with about 7 % to total NMVOC emissions in EU-27+2 including biogenic emissions if the climatic conditions are similar to the selected average year. Relating only to anthropogenic NMVOC emissions, the paint sector has a share of ~18 %. In 2010, about 45 % of the NNVOC emissions from the paint sector originate from decorative paints and vehicle refinishing products (see Table 3).



based on [EEA, 2008a] and [IIASA, 2008]

Figure 6: Exemplary VOC emissions share from biogenic sources in an average meteorological year and share of VOC from anthropogenic sources (2010) including paints sector in EU-27

Based on international emission source categories, Figure 7 shows key contributors of anthropogenic NMVOC. The data set was compiled by the European Environmental Agency, based on Member State data for 2007 [EEA, 2009]. Based on this data, 'decorative coating application' has a share of 4 % in 2007.



[EEA, 2009]

Figure 7: Key NMVOC emission source categories in EU-27 in 2007

1.2. Project objective

Aims of the project are:

- In-depth-analysis of the first year of application of Directive 2004/42/EC
- Preparation of a review of the Directive (possibly with extended scope)
- Preparation of a draft report to the European Parliament on the Directive

The project report shall include

- scenarios for VOC reduction expected for 2010/2015/2020, based on the current scope of the Directive, impact assessment of options for an extension of the scope of the Directive (task 1),
- update of socio economic impacts related to the current scope (task 2),
- assessment of implementation of the analysis method of annex III, of interference of Directive 2004/42/EC with Directive 1999/13/EC, and an evaluation of Member States' monitoring programmes (task 3);
- results of stakeholder consultations (task 4).

On the kick-off meeting held in January 2008, the Commission has underlined that the project team shall not focus on any specific product group when assessing the possible extension of the scope of Directive 2004/42/EC (except from paint aerosols and phase-II-limits for vehicle refinishers that have to be assessed following Article 9 of the Directive).

The Commission has stressed that any proposal for extension of the scope shall be based on the technical feasibility for VOC reduction and on the outcome of the related impact assessment.

1.3. Project team

Table 4 shows the institutions involved and the members of the project team.

Table 4: Project institutions and core project team

Institution	Name
Ökopol GmbH – Institute for Environmental Strategies	Christian Tebert (project manager)
	Susanne Krause
IVAM Research and consultancy for a sustainable society	Jeroen Terwoert
	Pieter van Broekhuizen
Regional Environmental Centre (REC)	Imola Koszta
	Tamas Kristof Kallay
Risk & Policy Analysts Ltd (RPA)	Meg Postle
	Daniel Vencovscy
	David Fleet
USTUTT University of Stuttgart - Institute for Energy Economics and the Rational Use of Energy (IER)	Jochen Theloke
	Volker Klotz
	Wolf Müller

2. Methodology

The following chapters describe the methodological approach of the project and present the project steps.

2.1. Overview

The first project phase included a combination of data gathering and information collection, involving stakeholders and Member States, aiming at the development of options for the extension of the scope of Directive 2004/42/EC and assessing problems of implementation related to the directive's current scope.

In the second project phase options for potential amendment of Directive 2004/42/EC were proposed to the Commission and agreed upon. The options have been further analysed by undertaking an impact assessment with cost-benefit calculations, according to the Commission's guideline on impact assessments. [COM, 2009] In parallel, monitoring programmes have been evaluated, elaborated by the Member States based on Article 6 of Directive 2004/42/EC. Finally, solutions for problems with the current scope of the Directive have been developed.

2.2. Activities of the first project phase

Following the methodological approach described above, an intensive data gathering was undertaken during the first phase of the project execution.

Data gathering at stakeholders was combined with effort to identify new socio-economic impacts and consultations to identify implementation problems. In parallel, stakeholders have been asked for proposals for possible amendments.

A common meeting of Member State representatives and stakeholders was considered as helpful for the data collection exercise and for having a first exchange of experience regarding the first year of implementation of the directive.

For this purpose the regular scheduled meetings of the European Commission's VOC Committee (representatives of all Member States) was used to organise, on the same day, a subsequent workshop for participation of all Member State representatives, together with all relevant stakeholders, to present the project.

The event took place on 9 April 2008 and with participation of the Member State representatives and all relevant stakeholder associations. In the meeting the objective, methodology and timeline of the Directive 2004/42/EC revision project were presented by the project team. CEPE gave a short presentation of implementation problems identified so far (see annex 28, page 341).

The project team started data and information collection after the VOC Committee meeting. For this purpose, meetings with the most relevant stakeholders were held, followed by email communication (CEPE, FEA, FEICA, Colipa, A.I.S.E., EURMIG, and CEFIC/ESIG). Additionally, questionnaires were sent to users of products regulated under Directive 2004/42/EC via European associations of painters (UNIEP) and vehicle refinishing shops (AIRC, CECRA).

As most member companies or member associations of relevant European industry associations are located in EU-15, an additional data collection was started in the New Member States, as well as in Croatia and Turkey.

Member States had to report officially on Directive 2004/42/EC implementation by July 2008 at the latest, using a questionnaire format published by the Commission [COM, 2007c]. The Commission's questionnaire includes several questions with importance to the project (e.g. reporting on implementation problems and suggestions to overcome). By 21 November 2008 the questionnaire had been answered by 25 Member States, lacking information from France and Luxembourg.

The project team set up an additional questionnaire to Member States with 13 specific questions for obtaining more detailed information on certain issues. By 21 November feedback had been obtained from 22 Member States, lacking information from France, Germany, Italy, Luxembourg and Portugal.

2.3. Activities of the second project phase

The second project phase started with a meeting with the Commission in December 2008 to discuss the interim report and the details of the second project phase, lasting until the draft final report delivery on 21 May 2009.

Amendment options described in the interim report have been further assessed by the project team, in particular those for which it was agreed with the Commission to undertake an impact assessment according to the Commission's Impact Assessment Guideline [COM, 2009].

Stakeholders have been informed about the selected options, and a stakeholder consultation has been realised to assess the expected impact of each amendment option via questionnaires. Additionally to individual meetings with stakeholders, a workshop was organised for Member States and stakeholders in May 2009.

Several impact assessments including cost-benefit analyses have been conducted, including the calculation of the VOC reduction potential of the option for the years 2010, 2015 and 2020. In addition to the impact assessment, proposals for more precise wording of Directive 2004/42/EC have been assessed by the project team, by consultation of stakeholders and Member State authorities.

Finally, an evaluation of experiences with national monitoring programmes was undertaken, based on translations of written monitoring programmes, voluntarily delivered to the Commission together with the first regular report in July 2008.

In May 2009, stakeholders and Member States have been invited to a workshop to discuss first findings of the cost-benefit analysis and the impact assessment and to discuss solutions for lacking information.

End of May a draft final report was delivered to the Commission. After work on comments, the first version of the final report was handed over in June 2009.

2.4. General approach of the cost-benefit analysis

In the impact assessments of the proposed options, the project team examined and quantified the prevented impacts on human health, ozone and damages to crops resulting from changes in regulatory measures with respect to VOC limit values for different coatings and other products such as cosmetics or floor covering adhesives. These estimations were accomplished for currently available data and for extrapolations of data to the years 2010, 2015 and 2020.

As a starting point for the cost-benefit analysis, the potential VOC reductions for each of the options had to be estimated for each of the analysed countries, i.e. the EU-27 Member States plus Croatia and Turkey. These reduction potentials enabled the quantification of prevented external costs and the cost-benefit analyses of the impact assessments. For the estimations, data provided by stakeholders was analysed and data gaps were identified. In most of the assessments, data was only available for the EU-15 Member States and a few additional countries. To overcome this difficulty and to allow for a complete cost-benefit analysis, data for countries where no figures could be provided by stakeholders had to be estimated separately. Therefore, two similar approaches were followed for these estimations.

First, data for options were estimated applying national data provided by EuroStat on the Gross Domestic Product (GDP). These data were extracted from the EuroStat statistical database accessible via the internet.

The applied GDP data refers to GDP at market prices for the respective year. This approach was mostly applied wherever data provided by stakeholders allowed for an estimation of a market specific growth rate and where only the distribution of aggregated figures or the estimation of national data for certain countries was required. A projection of data into future years, as part of the impact assessment, was not possible using GDP data, mainly because of the high level of uncertainty of predictions of national accounts development given the current economic situation. The data on national GDP for EU-27 Member States plus Croatia and Turkey that were applied in the estimations for several of the options are presented in Table 5. As can be seen from the table, the data were collected for 2003, 2005, 2006 and 2007, as these were the scenarios which were covered by figures provided by stakeholders.

Table 5: National data on GDP at current market prices for 2003, 2005, 2006 and 2007

Country	Gross Domestic Product (GDP) [million Euros]			
	2003	2005	2006	2007
Austria	223,302.3	244,453.1	257,294.5	270,836.8
Belgium	274,726.0	302,112.0	318,223.0	334,917.0
Bulgaria	17,766.8	21,882.3	25,238.2	28,898.6
Cyprus	11,785.0	13,659.3	14,673.2	15,667.1
Czech Republic	80,924.1	100,190.1	113,458.5	127,142.9
Denmark	188,500.3	207,366.9	218,341.4	226,544.4
Germany	2,163,800.0	2,243,200.0	2,321,500.0	2,422,900.0
Estonia	8,692.6	11,090.6	13,104.3	15,270.3
Finland	145,795.0	157,070.0	167,009.0	179,659.0
France	1,594,802.0	1,726,068.0	1,807,462.0	1,894,646.1
Greece	171,409.8	197,645.0	213,206.7	228,180.3
Hungary	74,579.6	88,663.9	90,007.0	101,370.2
Ireland	139,441.9	162,168.0	177,286.0	190,602.5
Italy	1,335,353.7	1,429,479.3	1,485,377.3	1,544,915.1
Latvia	9,977.8	13,012.2	16,046.7	21,111.0
Lithuania	16,497.1	20,870.1	23,978.5	28,422.9
Luxemburg	25,834.3	30,237.1	33,921.1	36,411.1
Malta	4,421.4	4,799.1	5,109.7	5,464.0
Netherlands	476,945.0	513,407.0	539,929.0	567,066.0
Poland	191,643.8	244,420.1	272,088.9	310,612.9
Portugal	138,582.1	149,123.3	155,446.3	163,190.1
Romania	52,576.5	79,801.9	97,751.0	123,846.8
Slovakia	29,485.6	38,489.9	44,566.7	54,856.6
Slovenia	25,735.9	28,712.2	31,013.6	34,470.9
Spain	782,929.0	908,792.0	982,303.0	1,050,595.0
Sweden	275,657.0	294,673.5	313,449.8	331,225.9
United Kingdom	1,647,055.6	1,831,683.2	1,938,978.8	2,046,535.3
Total EU-27	10,108,220.2	11,063,070.1	11,676,764.2	12,355,358.8
Croatia	29,993.1	35,721.5	39,092.5	42,823.7
Turkey	268,330.7	386,936.8	419,232.1	471,972.2

Source: EuroStat

The second approach for estimating national figures on consumption refers to national data on population, again provided by the EuroStat database. National population data was mostly applied in cases where no market development could be estimated based on figures given by stakeholders. Furthermore, population data was applied in options where the distribution of aggregate values was assumed to be depending on the total amount of people within one country rather than the economic performance of the country.

As national population figures were used to estimate future scenarios for some of the analysed options, data on population development for the EU-27 Member States was taken from the EuroStat database. In these cases, national growth rates for population were assumed to reflect the development of the market of the respective products. This approach can be regarded as a conservative approach given an EU-27 growth rate of population of 4.2% from 2007 to 2020.

Table 6 presents detailed data for national population for 2006 and 2007 as well as projections for 2010, 2015 and 2020. For Croatia and Turkey, data on national population for 2010, 2105 and 2020 was extrapolated applying the average growth rates for the EU-27 as there are no data provided by EuroStat.

Table 6: National data on population for 2006, 2007, 2010, 2015 and 2020

Country	Population				
	2006	2007	2010	2015	2020
Austria	8,265,925	8,298,923	8,404,899	8,569,899	8,723,363
Belgium	10,511,382	10,584,534	10,783,738	11,069,711	11,321,733
Bulgaria	7,718,750	7,679,290	7,564,300	7,382,440	7,187,743
Cyprus	766,414	778,684	820,709	888,003	954,522
Czech Republic	10,251,079	10,287,189	10,394,112	10,496,514	10,543,351
Denmark	5,427,459	5,447,084	5,512,296	5,591,046	5,661,099
Estonia	1,344,684	1,342,409	1,333,210	1,323,261	1,310,993
Finland	5,255,580	5,276,955	5,337,461	5,428,612	5,500,929
France	4,209,019	61,538,322	62,582,650	64,202,980	65,606,558
Germany	82,437,995	82,314,906	82,144,902	81,857,964	81,471,598
Greece	43,758,250	11,171,740	11,306,765	11,475,669	11,555,829
Hungary	10,076,581	10,066,158	10,023,453	9,964,433	9,892,967
Ireland	11,125,179	4,312,526	4,614,218	5,051,992	5,404,231
Italy	58,751,711	59,131,287	60,017,346	60,928,533	61,420,962
Latvia	2,294,590	2,281,305	2,247,275	2,200,033	2,151,445
Lithuania	3,403,284	3,384,879	3,337,008	3,275,272	3,219,837
Luxemburg	469,086	476,187	494,153	523,024	551,045
Malta	405,006	407,810	413,542	420,933	427,045
Netherlands	16,334,210	16,357,992	16,503,473	16,717,366	16,895,747
Poland	38,157,055	38,125,479	38,092,173	38,068,048	37,959,838
Portugal	10,569,592	10,599,095	10,723,195	10,947,334	11,108,159
Romania	21,610,213	21,565,119	21,333,838	21,102,552	20,833,786
Slovakia	5,389,180	5,393,637	5,407,491	5,426,588	5,432,265
Slovenia	2,003,358	2,010,377	2,034,220	2,052,980	2,058,003
Spain	62,998,773	44,474,631	46,673,372	49,381,307	51,108,563
Sweden	9,047,752	9,113,257	9,305,631	9,588,259	9,852,965
United Kingdom	60,425,786	60,816,701	61,983,950	63,791,983	65,683,056
Total EU-27	493,007,893	493,236,476	499,389,380	507,726,736	513,837,632
Croatia	4,442,884	4,441,238	4,496,640	4,571,712	4,626,737
Turkey	72,519,974	69,689,256	70,558,598	71,736,581	72,599,988

Source: EuroStat

In order to test the applicability of the national GDP and population data for estimating the national consumption figures for the different options, the above presented data on GDP and population were compared to national consumption data for decorative paints of different categories of Directive 2004/42/EC provided by CEPE. Table 7 shows data on national GDP and national population from EuroStat as well as national paint consumption from CEPE for 2003 and 2006. As these data only cover 19 countries of the EU-27+2, the correlation between national GDP or national population and total paint consumption could not be estimated for all of the countries to be covered in the impact assessment. It has been assumed that the results for these 19 countries are also valid for those countries not covered by CEPE.

The correlation coefficients for GDP and consumption were calculated to be 0.86 for 2003 and 0.91 for 2006. For population the estimation of correlation coefficients resulted in 0.88 and 0.81 for 2003 and 2006. These results show that national GDP data and national population data can used to estimate national consumption data.

Table 7: Comparison of GDP, population and paint consumption data for 2003 and 2006

Country	GDP [million Euros]		Population		Paint consumption [1000 t]	
	2003	2006	2003	2006	2003	2006
Belgium	274,726.0	318,223.0	10,355,844	10,511,382	43,382.35	39,577.32
Denmark	188,500.3	218,341.4	5,383,507	5,427,459	31,139.46	11,624.45
Germany	2,163,800.0	2,321,500.0	82,536,680	82,437,995	650,065.52	687,362.19
Ireland	139,441.9	177,286.0	11,006,377	11,125,179	35,041.00	41,622.00
Greece	171,409.8	213,206.7	41,663,702	43,758,250	72,516.56	80,147.38
Spain	782,929.0	982,303.0	61,831,779	62,998,773	493,690.00	517,486.00
France	1,594,802.0	1,807,462.0	3,963,665	4,209,019	264,511.46	435,391.00
Italy	1,335,353.7	1,485,377.3	57,321,070	58,751,711	334,356.77	342,439.45
Cyprus	11,785.0	14,673.2	715,137	766,414	n.a.	32,055.00
Netherlands	476,945.0	539,929.0	16,192,572	16,334,210	140,600.00	120,629.42
Austria	223,302.3	257,294.5	8,102,175	8,265,925	31,437.56	41,580.20
Poland	191,643.8	272,088.9	38,218,531	38,157,055	220,122.00	240,654.00
Portugal	138,582.1	155,446.3	10,407,465	10,569,592	112,849.60	103,333.52
Romania	52,576.5	97,751.0	21,772,774	21,610,213	n.a.	57,665.00
Slovakia	29,485.6	44,566.7	5,379,161	5,389,180	11,653.42	10,624.53
Finland	145,795.0	167,009.0	5,206,295	5,255,580	29,888.24	26,486.71
Sweden	275,657.0	313,449.8	8,940,788	9,047,752	69,652.87	81,575.27
United Kingdom	1,647,055.6	1,938,978.8	59,437,723	60,425,786	397,980.00	385,810.00
Croatia	29,993.1	39,092.5	4,442,744	4,442,884	n.a.	14,679.00

Source: EuroStat

After preparing the data sets to cover all of the EU-27 Member States plus Croatia and Turkey, the data for current years was extrapolated to the years 2010, 2015 and 2020 and two different sets of scenarios where estimated for each of these years.

On the one hand, a “business-as-usual” (BAU) scenario was created. For this scenario, no new regulatory measures were assumed to be implemented. On the other hand, one or more scenarios including the respective new regulations on VOC limit values were compiled. The difference in the total amount of VOC emissions between both scenarios reflected the reduction potential in VOC emissions. This information was then applied in the calculations of the external costs and the cost-benefit analysis.

The cost-benefit analysis was performed by USTUTT-IER applying the methodology of the CAFE[14] programme. For the calculations the EcoSense[15] model together with the CAFE approaches for the quantification of impacts and the valuation of the calculated endpoints has been used. Thus concentration-response functions published in the CAFE report have been applied to quantify the impacts. Mortality has been expressed by life years lost. To value a life year lost the median valuation of a VOLY[16] has been applied.

For comparision the last updated concentration-response functions and monetary values of ExternE[17] as reported in the NEEDS[18] project have been used. There are only small changes in the approaches observable and have no relevant impact on the results of this report.

The changes in ground level Ozone concentrations due to emission reductions of VOC emissions have been modelled by the use of a parameterized version of the Eulerian EMEP dispersion model [Tarrasón, 2008].

A detailed description of the approach to quantify the benefits is provided in annexes 18 and 19.

[14] CAFE: The Clean Air for Europe Programme

[15] The EcoSense model is an integrated atmospheric dispersion and exposure assessment model with implements the impact pathway approach developed within ExternE.

[16] VOLY: Value of a life year.

[17] ExternE: Externalities of Energy. Research project series of the European Commission. http://www.externe.info

[18] NEEDS project: New Energy Externalities Development for Sustainability; http://www.needs-project.org

3. Consultation on implementation of Directive 2004/42/EC

3.1. Implementation problems

The following chapters evaluate problems identified by Member States and stakeholders when implementing Directive 2004/42/EC.

According to the contract, the project team has collected information on general implementation problems and on new socio-economic impacts that have not been addressed before Directive 2004/42/EC has been passed (chapter 3.2).

The task to further investigate new socio-economic impacts is verbalised in Article 9 (c) of Directive 2004/42/EC, inviting the Commission to submit to the European Parliament and the Council a report examining among others 'any new element relating to the socio-economic impact of the application of phase II as foreseen for paints and varnishes'.

Member States and stakeholders have reported general implementation problems. For problems related to the product category definitions for decorative paints see annex 1.1 (p. 3), for problems with category definitions for vehicle refinishing products see annex 2.2 (p. 16).

Additionally, specific information on the following issues was collected:

- Problems connoting new socio-economic impacts (not expected when Directive 2004/42/EC was adopted) are described in chapter 3.2.
- Problems related to the fact that protective coatings are not covered by Directive 2004/42/EC
- A summary of problems due to the definition of 'buildings' in Directive 2004/42/EC and potential solutions of the problem can be found in chapter 4.2 on page 83 (Option 1). Detailed results of the consultation can be found in annex 3.1 on page A-24.
- A summary of problems and potential solutions related to analytical methods of Directive 2004/42/EC are presented in chapter 8, page 114. For detailed results of the consultation see annex 3.2 on page A-27.
- A summary of problems and potential solutions due to an overlap of Directive 1999/13/EC and Directive 2004/42/EC can be found in chapter 3.3. For detailed results of the consultation see annex 3.3 on page A-34.

3.2. Problems connoting new socio-economic impacts

In the studies preceding Directive 2004/42/EC several socio-economic impacts were evaluated [Van Broekhuizen et al., 2000] [Ritchie et al., 2000] [EC, 2002]. In the course of the current study, stakeholders were asked to report additional, unexpected socio-economic impacts of implementation of Directive 2004/42/EC.

Some Member States and stakeholder associations representing end users have argued that low-VOC coatings in some countries would reduce the length of the 'painting season', as it would be difficult to use the products in cold, humid circumstances in winter.

The project team has evaluated this issue and has come to the conclusion that potential problems with water-based coatings have been discussed in studies prior to Directive 2004/42/EC [Van Broekhuizen et al., 2000] with the conclusion that problem may occur only if Directive 2004/42/EC would prescribe the *exclusive use of water-based low-VOC* coatings. As this is not the case, the issue has not been further evaluated.

One new socio-economic impact was identified, reported by CEPE:

- Costs for (re-)labelling products under the scope of Directive 2004/42/EC.

As this issue was not assessed in the studies prior to the design of the directive, it is considered as important to evaluate, in particular on the background that the reduction of existing VOC limits would be accompanied with these costs, as well as potential extension of the scope of the directive to other product groups.

No cross-media effects or other unexpected socio-economic impacts have been reported by CEPE or by paint user associations arising from shifts from solvent-based to water-based technologies.

Costs for labelling

CEPE has collected data to estimate the costs for labelling in order to comply with Directive 2004/42/EC. Detailed results can be found in annex 26. The investigation involved the following cost items related with labelling:

- Origination and approval for the livery;
- Scrapping of stocks of obsolete labels or pre-decorated containers;
- Application of stickers/over-labels to make existing stock compliant;
- Generation and dissemination of modified datasheets
- Takeback and destruction of non-compliant products

CEPE calculation was based on 4000 companies in EU-27 with 1000 – 2000 products each. CEPE estimated that 50 % of the changes were linked to Directive 2004/42/EC. Assuming an average cost of €150 per stock keeping unit; calculations summed up costs between €300 – 600 million, additionally €1 million costs for scrapping of stocks of obsolete labels or pre-decorated containers was calculated, together with €22.5 million for re-labelling (for 5 % re-labelling).

Costs for modifications of data sheets have been assumed with €150 per product for renewing the technical and the safety datasheet. All together, costs of €600 million Euro are estimated by CEPE being linked with labelling for compliance with Directive 2004/42/EC. Another cost of €141 million was estimated for takeback/destruction of non-compliant products.

3.3. Problems due to overlap of Directive 2004/42/EC with Directive 1999/13/EC and proposals for minimisation

In the following chapter interference of Directive 2004/42/EC with Directive 1999/13/EC[19] is being assessed. The interference was identified by several Member States and stakeholders, some of them seeing a problem arising from this so-called "overlap" of the directives (for details see Annex 3.3, page A-34).

3.3.1. Legal context of the directives

Directive 1999/13/EC is based on Article 175 of the Treaty on European Union ("environmental protection"). Article 176 of the Treaty allows Member States to put more stringent requirements to provide additional environmental protection. As a consequence, some Member States have chosen to extend the scope of the national legislation implementing Directive 1999/13/EC beyond the scope of the Directive itself by applying lower solvent consumption thresholds (determining whether an activity is regulated or not) than strictly required by the Directive.

Directive 2004/42/EC is based on Article 95 of the EU Treaty ("internal market"), not allowing Member States to put different requirements. However, Article 3(2) of Directive 2004/42/EC foresees that Member States shall exempt products from compliance with the VOC limit values under two conditions:

a) The products are sold for exclusive use in an activity covered by Directive 1999/13/EC, and

b) The activity is carried out in a registered or authorised installation according to articles 3 and 4 of Directive 1999/13/EC.

As a consequence, paints of the same product category are offered in compliance with Directive 2004/42/EC and not in compliance (indicating the need for exclusive use for activities carried out in registered/authorised installations covered by Directive 1999/13/EC).

This exemption is clear for those installations which are operating activities mentioned in Annex I of Directive 1999/13/EC above the solvent consumption thresholds mentioned in Annex IIA of that Directive. However, two issues have been identified where the overlap between both Directives may cause difficulties.

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[19] Council Directive 1999/13/EC of 11 March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations

The first one is whether the exemption can also be applied for paints used in installations operating an Annex I activity but **not** exceeding the thresholds set out in Annex IIA. Due to the requirement under b), this could only be considered for installations which are subject to the same authorisation/registration requirements as set out in articles 3 and 4 of Directive 1999/13/EC, i.e. for Member States where lower solvent consumption thresholds have been set for implementing the Directive.

The second one is related to the operation of different activities within one installation, some of which are requiring the use of 2004/42/EC compliant products, while others are not.

Solvent Consumption Threshold Case
Ambiguity on whether the use of products complying with Directive 2004/42/EC is mandatory for operating an activity mentioned in Annex I of Directive 1999/13/EC but not exceeding the solvent consumption threshold of Directive 1999/13/EC (see chapter 3.3.2).

Multiple Activities Case
Ambiguity on requirements for installations carrying out an activity where the use of products complying with Directive 2004/42/EC is obligatory, and also carrying out an activity outside the scope of Directive 2004/42/EC (see chapter 3.3.3).

Other issues
An additional issue is that for building parts (trims, fittings and associated structures) in case of on-site repair away from an installation products complying with Directive 2004/42/EC will have to be used even if the object was originally coated with non-complying paints inside a registered/authorised installation under Directive 1999/13/EC.

For the first two cases, in the following chapters an analysis of the overlap problem and options for solving the problems is undertaken. Specific case studies have been asked from the Member States but could not be provided.

3.3.2. Solvent consumption threshold case

Background

Directive 1999/13/EC is limiting VOC emissions from installations operating certain activities using organic solvents (listed in Annex I of the Directive) if the solvent consumption in any of these activities exceeds the annual solvent consumption thresholds set out in Annex IIA of the Directive. The "consumption" is defined as "the total input of organic solvents into an installation per calendar year, or any other 12-month period, less any VOCs that are recovered for re-use".

This means that, unlike other Directives related to industrial emissions (e.g. IPPC Directive, ETS Directive, LCP Directive), Directive 1999/13/EC does not use the capacity (e.g. potential maximum consumption) of a given installation as the criterion to define its scope, but rather the **actual** solvent consumption within the installation (article 1: "(…) in so far as they are operated above the solvent consumption thresholds in Annex IIA").

As a result, activities may exceed the threshold during one year and be below it during the next year or vice versa. Consequently, their coverage under the scope of the Directive may change from year to year. In order to comply with the obligations of articles 3 and 4 of the Directive, competent authorities will have to ensure that all installations covered by the Directive are either registered or permitted. In practice, competent authorities will therefore have to ensure that this requirement applies to installations where the solvent consumption thresholds are de facto exceeded but also to those installations where it is very likely that the thresholds will be exceeded in one or several years.

In order to decide whether a product could be exempted from Directive 2004/42/EC on the basis of article 3(2) of Directive 2004/42/EC, it has to be considered whether the activity in which this product is being used is 1° covered by Directive 1999/13/EC and 2° carried out in a registered or authorised installation according to Articles 3 and 4 of that Directive. The overlap issue identified and discussed in this section is due to different interpretations of these conditions.

Description of the overlap problem

As stated above, Member States are allowed to implement the provisions of Directive 1999/13/EC in a stricter way, based on Article 176 of the Treaty on European Union, e.g. by setting lower solvent consumption thresholds than the ones set out in Annex IIA, thus bringing more installations under the scope of the national regulation implementing the Directive. This has been the case in some Member States, e.g. the threshold for wood coating (Directive 1999/13/EC: > 15 t/a) was set in the Czech Republic at > 0.6 t/a, and in Austria and Germany at > 5 t/a.

Figure 8 distinguishes three groups of activities according to their annual solvent consumption in relation to the thresholds defined at national and European level as well as their potential registration/authorisation.

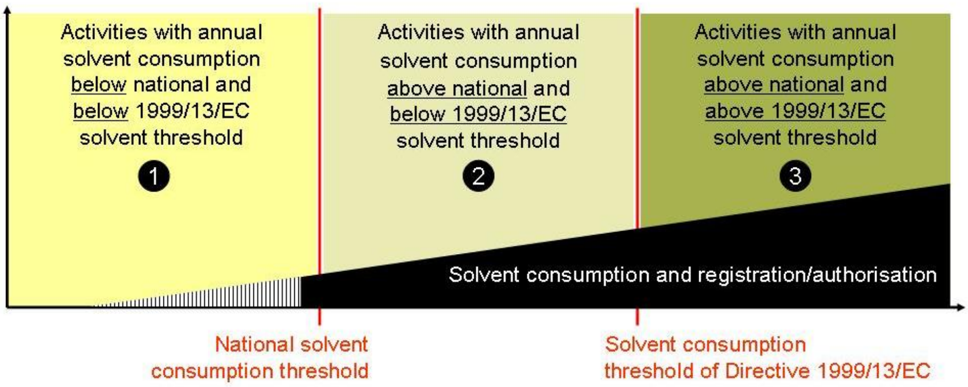


Figure 8: Groups of activities according to their annual solvent consumption and registration/authorisation

Group 1 installations are not required to be registered or authorised according to Directive 1999/13/EC as they are not covered by the legislation transposing the Directive in the Member State. In that case, it is evident that coating products which are used in these installations have to comply with the VOC limits of Directive 2004/42/EC when trims and fittings of buildings and associated structures are coated.

However, if group 1 installations have been registered or authorised in accordance with articles 3 and 4 of Directive 1999/13/EC, similar overlap issues may arise as for group 2 installations.

Group 2 installations are required to be registered or authorised due to the national legislation transposing Directive 1999/13/EC setting lower thresholds than the Directive itself. In that case, it is unclear whether/when coating products under the scope of Directive 2004/42/EC have to comply with the VOC limits of Directive 2004/42/EC.

Group 3 installations are subject to Directive 1999/13/EC. If these installations are registered/authorised and operated in compliance with the requirements of the Directive and use is made within these installations of products covered by Directive 2004/42/EC, those products shall be exempted under article 3(2) of Directive 2004/42/EC and do not have to fulfil the VOC limits of Directive 2004/42/EC.

Ambiguity has been reported from Member States and stakeholders whether the use of products complying with Directive 2004/42/EC is obligatory in case of installations registered/authorised according to Articles 3 and 4 of Directive 1999/13/EC while not exceeding the solvent consumption threshold for the activity set out in Annex IIA of that Directive. As mentioned above, such registered/ authorised installations can potentially be found within groups 1 and 2 as shown in Figure 8.

Additionally, Member States have reported problems to monitor the restricted use of products exempted from the requirements of Directive 2004/42/EC.

A particular issue relates to Member States where lower solvent consumption thresholds have been implemented than those set by Directive 1999/13/EC, but where requirements for those activities in registered/authorised installations are less strict than those defined in Directive 1999/13/EC. Table 8 shows examples of Member States where lower thresholds have been set for wood coating. Less strict requirements than set by Directive 1999/13/EC are marked in bold.

Table 8: Examples of provisions by Member States having set lower solvent consumption thresholds for wood coating

Provision for wood coating	Provisions of Directive 1999/13/EC	Exemplary provisions of Member States for activities below 1999/13/EC solvent consumption thresholds			
		Austria	Czech Republic		Germany
Solvent consumption threshold [t/a]	> 15 - 25	> 5 - 15	> 0.6 - 5	> 5 - 15	> 5 - 15
Emission limit for fugitive emissions (% of solvent input)	25%	25%	25%	20%	- (4)
Emission limit in waste gases from coating [mgC/Nm3]	100 (1)	30 (2) 75	100	50 (3)	- (4)
Emission limit in waste gases from drying [mgC/Nm3]	100 (1)	30 (2) 75	100	75 (3)	- (4)

(1) under contained conditions (not explicitly mentioned in Austrian and Czech Republic regulation)
(2) In case of thermal waste gas treatment
(3) If coatings with a low content of organic solvents (i.e. less than 10%) are applied in the coating system and if TOC emission limits are not achieved, the regional authority may, based on an expert's opinion, change the emission limit value.
(4) Use of reduction scheme is obligatory from 2013 on. VOC emissions have to be minimised by the use of solvent-reduced state-of-the-art coatings. This is valid for new installations from 1.11.2007 on, and valid for existing installations from 1.1. 2013 on. An interpretation of "solvent-reduced state-of-the-art products" is done by the competent authority.

Table 8 shows that for wood coating activities in Germany a lower solvent consumption threshold applies than under Directive 1999/13/EC, bringing more installations under the scope of the regulation. However, for existing installations with a solvent consumption of > 5 – 15 t/a, less strict requirements are in force until 31.12.2012 than set by Articles 3 and 4 of Directive 1999/13/EC. This means that the regulation can not ensure that the conditions of Article 3(2) of Directive 2004/42/EC for granting exemptions are fulfilled by all of these installations. Therefore installations with a solvent consumption of > 5 – 15 t/a may have to use products complying with Directive 2004/42/EC when coating trims and fittings of buildings or associated structures (see interpretation options below). The requirement of using "solvent-reduced state-of-the-art products" in new installations and, from 2013 on, in existing installations can be regarded as equivalent to the obligatory use of products complying with Directive 2004/42/EC if "solvent-reduced state-of-the-art products" are interpreted by competent authorities as products complying at least with the VOC limits of Directive 2004/42/EC.

Options for interpreting the exemption clause in Article 3(2) of Directive 2004/42/EC

Option A

After discussion in the VOC Committee[20], the Commission has indicated in an answer to frequently asked questions[21] that the exemption of Article 3(2) of Directive 2004/42/EC (allowing the use of non-complying products in certain installations) also applies in case of installations with a solvent consumption below the relevant threshold of Annex IIA, but authorised/registered according to

20 The Commission has established the VOC Committee according to Article 13 of Directive 1999/13/EC, consisting of representatives of the Commission and all Member States.

21 http://ec.europa.eu/environment/air/pollutants/stationary/solvents/faq_en.htm

national law in line with the provisions of Articles 3 and 4 of Directive 1999/13/EC.

This means that products can be exempted from compliance with the requirements of Directive 2004/42/EC for their exclusive use in certain installations, if the activity they are used for is registered/ authorised in accordance with Articles 3 and 4 of Directive 1999/13/EC. For granting the exemption it is not necessary that the activity is operated above the solvent consumption threshold set out in Annex IIA of Directive 1999/13/EC.

Option B

Article 3(2) of Directive 2004/42/EC restricts the exemption to installations within the **scope** of Directive 1999/13/EC. Therefore, a "strict" interpretation of Article 3(2) of Directive 2004/42/EC could also be defended. According to such a strict interpretation, coatings shall only be exempted from the requirements of Directive 2004/42/EC if they are used for activities actually operating <u>above</u> the thresholds set out in Annex IIA of Directive 1999/13/EC and which are registered/authorised and operated in line with the provisions of Articles 3 and 4 of Directive 1999/13/EC. As a consequence, an activity exceeding a national solvent consumption threshold but not exceeding the threshold set by Directive 1999/13/EC would have to use products complying with Directive 2004/42/EC for objects under its scope, regardless of whether the activity is registered/authorised and operated in line with the provisions of Articles 3 and 4 of Directive 1999/13/EC or not.

Option C

A solution for enhancing the correct use of products exempted from compliance with Directive 2004/42/EC may be the introduction of a certificate for registered/authorised installations according to Articles 3 and 4 of Directive 1999/13/EC as a pre-condition to purchase products exempted from compliance with Directive 2004/42/EC.

Option D

Amendment of Directive 2004/42/EC to extend the exemption of Article 3(2) to all activities under Annex I of Directive 1999/13/EC regardless whether they provide of a registration/authorisation or whether they are operated in line with the provisions of Articles 3 and 4 of Directive 1999/13/EC. Under this option, Directive 2004/42/EC would cover products used outside of installations ("in-situ").

Assessment of options

In the following section, the pros and cons of the four options are being assessed. The pros and cons are evaluated by using the following criteria:

1) Qualification to reach the **environment/health-oriented aim** of VOC emission reduction (Recitals 7, 8, 9 and Article 1 of Directive 1999/13/EC; Recitals 3, 9 and Article 1 of Directive 2004/42/EC)

2) Qualification to reach the **market-oriented aim** of Directive 2004/42/EC: Avoid unnecessary barriers to trade and distortion of competition within the internal market. Ensure a free movement of goods by establishment of harmonised VOC limit values (Recitals 4, 5 of Directive 2004/42/EC).
3) Qualification to provide **clarity** for authorities and stakeholders in overlap cases, to reduce administrative burden and to facilitate implementation by operators.

Assessment of Option A

1) Environment/health-oriented aim of the directives

Recital 17 of Directive 2004/42/EC indicates the rationale for the exemption clause of article 3(2) of the Directive. It connotes that the provisions of Directive 1999/13/EC lead to "at least equivalent VOC emission reduction" as the use of products complying with the VOC limits of Directive 2004/42/EC ("The Directive should not apply to products sold for exclusive use in installations authorised according to Directive 1999/13/EC where emission limiting measures provide alternative means of achieving at least equivalent VOC emission reductions").

Option A proceeds on the assumption that "at least equivalent VOC emission reduction" is achieved if an activity operates in line with the provisions of Articles 3 and 4 of Directive 1999/13/EC. Consequently, it is assumed that granting exemptions from VOC limits of Directive 2004/42/EC only under the condition that the activity is in line with the provisions of Articles 3 and 4 of Directive 1999/13/EC will lead to similar VOC emissions reduction. Therefore option A is appropriate to support the environment/health-oriented aim of the directives although a quantitative analysis would be needed to come to a definite conclusion.

In practice, lowering the solvent consumption thresholds on a national level and thereby extending the use of products not in compliance with the VOC limits of Directive 2004/42/EC can lead to additional monitoring and enforcement problems. Additional to a monitoring of placing on the market of products complying with Directive 2004/42/EC, a high number of small installations would have to be monitored under the national provisions of Directive 1999/13/EC. For example, in Germany, lowering the threshold for wood coating activities from 15 to 5 t/a has brought 139 % more installations under the scope of the national regulation in this sector (256 instead of 107). Directive 1999/13/EC could take up a provision that Member States before lowering the threshold values need to provide a monitoring concept showing that the inclusion of additional installations will not lead to monitoring problems.

Situations may occur where an activity has reduced its solvent consumption in the course of a year in such a way that it falls below the national solvent consumption threshold. For such a case, it should be clarified that under option A an operator applying coatings under the scope of Directive 2004/42/EC shall either use exclusively products in compliance with Directive 2004/42/EC or may alternatively opt for showing compliance with the provisions of Articles 3 and 4 of Directive 1999/13/EC, even if no solvent consumption threshold has been exceeded. Such clarification would help to support the environment/health-oriented aim of the directives as it would encourage the minimisation of solvent consumption without the necessity of using exclusively products complying with Directive 2004/42/EC once falling below the national solvent consumption threshold.

Option A provides a clear framework, also in cases where Member States have opted to set lower solvent consumption thresholds. Bringing more installations under the scope of the provisions of Articles 3 and 4 of Directive 1999/13/EC can lead to an additional VOC reduction because the scope of Directive 1999/13/EC is wider than the scope of Directive 2004/42/EC (e.g. the first covering all wooden objects compared to the second covering only wood coatings used for buildings, their trims, fixtures and associated structures). Option A is appropriate to support the environment/health-oriented aim of further VOC emission reduction on a national level by bringing more installations under the scope.

2) Market-oriented aim of Directive 2004/42/EC

Option A has no influence on the free movement of goods but leads to distortions of the market. Products not in compliance with the VOC limit values of Directive 2004/42/EC find an increased market in Member States where the solvent consumption thresholds have been lowered, because more installations are allowed to use such non-compliant products. In comparison, the market is smaller for non-compliant products in Member States where thresholds have not been lowered because installations being below the threshold have to use products according to the provisions of Directive 2004/42/EC. However, different market sizes do not hinder the free movement of goods and therefore do not contradict the market-oriented aim of Directive 2004/42/EC. A legal assessment would be needed to come to a definite conclusion.

3) Aim of clear regulations, facilitating easy understanding/implementation/ monitoring

Option A implies that for assessing whether products not complying with 2004/42/EC can be used in an installation, authorities or operators need to check whether a registration/authorisation under the national law transposing Directive 1999/13/EC has been done and whether the provisions of Articles 3 and 4 of Directive 1999/13/EC are fulfilled. Both conditions are clear, easy to understand and transpose as well as easy to monitor compliance (although the monitoring effort is higher because of the increased number of installations).

To improve understanding about the second condition, the wording of Article 3(2) of Directive 2004/42/EC could be improved, clarifying unambiguously that besides registration/authorisation of an installation also compliance is necessary with the provisions of Articles 3, 4, 5, 8 and 9 of Directive 1999/13/EC to allow the use of products not complying with the VOC limits of Directive 2004/42/EC. This new wording should underline that this condition also means compliance with the provisions of Articles 5, 8 and 9 of Directive 1999/13/EC (as this is part of the obligations under Articles 3 and 4), and consequently means compliance with the VOC emission limit values or the reduction scheme obligations set by Directive 1999/13/EC for activities exceeding the lowest threshold of Directive 1999/13/EC.

Despite publication of the present Commission's answer, ambiguity cases reported from authorities and stakeholders show that communication of guidance on the interpretation of the Directives' requirements to competent authorities and operators is important to improve their correct implementation.

Assessment of Option B

1) Environment/health-oriented aim of the directives

A strict interpretation of Article 3(2) of Directive 2004/42/EC would allow the use of products exempted from the VOC limits of Directive 2004/42/EC exclusively in installations that are registered/authorised within the scope of Directive 1999/13/EC and operated above the thresholds set out in Annex IIA of Directive 1999/13/EC.

If Member States lower the solvent consumption thresholds on a national level, installations additionally brought under the scope of the national transposition of Directive 1999/13/EC would have to use products complying with Directive 2004/42/EC when objects under its scope are coated. This would be the same requirement as foreseen if the installations do not exceed the national threshold value. An additional environmental benefit of lowering thresholds on national level can be seen in the introduction of monitoring of the correct use of products complying with Directive 2004/42/EC – a monitoring of the correct use of products is not foreseen under Directive 2004/42/EC. Another environmental benefit would result from the additional requirements going along with Directive 1999/13/EC (substitution/minimisation of substances classified with specific R phrases).

The disadvantage of this option is that it does not allow Member States to set stricter requirements regarding VOC emissions for installations additionally brought under the scope of the national transposition of Directive 1999/13/EC in cases where objects under the scope of Directive 2004/42/EC are coated. However, stricter requirements can be implemented when coating other objects not covered by the scope of Directive 2004/42/EC. Limiting stricter requirements to the coating of certain objects not under the scope of Directive 2004/42/EC means that – for object under the scope of Directive 2004/42/EC – this option would not lead to additional benefits than already achieved by Directive 2004/42/EC.

In activities where the solvent consumption in a specific year falls below the solvent consumption threshold of Directive 1999/13/EC, the activity would necessarily have to use exclusively products complying with Directive 2004/42/EC when coating objects under its scope. Where this is difficult to realise in a company, option B might hinder the maximum reduction of the solvent consumption and related VOC emission reduction. In such case, the option would not necessarily support the environment/health-oriented aim of the directives.

2) Market-oriented aim of Directive 2004/42/EC:

Option B is supported by the fact that Directive 2004/42/EC is based on Article 95 of the Treaty, aiming at an approximation of laws and harmonised conditions ("establishment and functioning of the internal market"). Under option B, the identification of activities that have to use products in compliance with the VOC limit values of Directive 2004/42/EC would be clear (as it is solely based on their solvent consumption) and harmonised in Europe. Products would find the same market restrictions as well in Member States where the solvent consumption thresholds have been lowered as in Member States where thresholds have not been lowered.

3) Aim of clear regulations, facilitating easy understanding/implementation/ monitoring:

Option B implies that for assessing whether products not complying with 2004/42/EC can be used in an installation, authorities or operators need to check whether a registration/authorisation under the national law transposing Directive 1999/13/EC has been done and whether the solvent consumption threshold of Annex IIA of Directive 1999/13/EC is actually exceeded. Both conditions are clear, easy to understand and easy to monitor.

However, allowing stricter requirements for coating of objects not covered by Directive 2004/42/EC would increase monitoring problems (see multi-activity overlap case in chapter 3.3.3).

Assessment of Option C

1) Environment/health-oriented aim of the directives

This option introduces a certificate for operators of installations carrying out activities registered or authorised under the national law transposing Directive 1999/13/EC and having proved compliance with the provisions of Articles 3 and 4 of Directive 1999/13/EC. The certificate shall ensure that products exempted from the requirements of Directive 2004/42/EC are only purchased by operators of installations where their exclusive use takes place under regulated conditions that produce at least the same emission reduction as if would have been achieved using products compliant with Directive 2004/42/EC. Therefore the solution supports the environmental/health-oriented aim of the directives. Details on implementing such solution would need to address the competent authority issuing the certificate, the legal basis, the frequency and the type of installation, whether all installations under the scope of Directive 1999/13/EC receive the certificate or only installations which might use products under the scope of Directive 2004/42/EC.

2) Market-oriented aim of Directive 2004/42/EC

The introduction of a certificate would not have an influence on the free movement of goods if it is restricted to products under the scope of Directive 2004/42/EC being exempted from the VOC limit provisions of Directive 2004/42/EC according to its Article 3(2).

3) Aim of clear regulations, facilitating easy understanding/implementation/ monitoring

The introduction of a certificate contribute to the aim of achieving correct use of products exempted from compliance with the provisions of Directive 2004/42/EC. A clear regulation is achieved if it can make sure that coating products not complying with the VOC limits of Directive 2004/42/EC are exclusively used in installations registered/authorised and in line with the provisions of Articles 3 and 4 of Directive 1999/13/EC.

This is not the case because the scope of the current Directive 2004/42/EC is limited to some coatings (used for buildings, their trims and fittings, and associated structures as well as used for certain vehicle repair activities). European-wide VOC limit provisions for other coatings not covered by the scope of Directive 2004/42/EC have not been implemented. Therefore, access to products not complying with the provision of Directive 2004/42/EC is possible (and allowed) for operators not registered/authorised and in line with the provisions of Articles 3 and 4 of Directive 1999/13/EC, e.g.

- for wooden coating activities when coating anything else but building trims, fittings and associated structures furniture producers (e.g. furniture, boats), or
- for plastic coating activities (e.g. automotive parts, machinery, boats, mobile phone parts, etc), or
- for metal coating activities when coating anything else but building trims, fittings and associated structures (e.g. automotive parts, machinery, boats, furniture, etc.), or
- for activities using vehicle repair coating for anything else but vehicles under the scope of Directive 2004/42/EC (e.g. trailers, motorcycles)

If the certificate is also granted to operators of these workshops, the correct use of products exempted from the scope of Directive 2004/42/EC is in question again because furniture coatings with high solvent content (not regulated by Directive 2004/42/EC) can also be used for wooden doors and windows (covered by Directive 2004/42/EC).

Furthermore, the introduction of a certificate would mean a significant additional administrative burden. A certificate would have to be renewed regularly e.g. each year or every second year after showing compliance with the provisions of Articles 3 and 4 of Directive 1999/13/EC. This means a high additional administrative burden compared with the present situation because currently compliance is monitored on a regular basis by the operator and may be monitored irregularly by the authority. Granting certificates also to cabinet makers and any other sector using coatings out of the scope of Directive 2004/42/EC is another significant administrative burden. Eligible companies carrying out activities out of the scope of Directive 2004/42/EC need to be identified and proved. No benefit would be achieved if at the end the certificate is granted to most installations although they are not registered/authorised nor in line with the provisions of Articles 3 and 4 of Directive 1999/13/EC but carrying out an activity out of the scope of Directive 2004/42/EC.

It can be concluded that the introduction of a certificate is a candidate for easing the monitoring of the correct use of products exempted from the provisions of Directive 2004/42/EC under the condition that the scope of that directive is no longer restricted to certain coatings but is extended to coatings for any object, in particular regarding the activities metal, plastic and wood coating. A quantitative analysis is however needed to assess whether the incorrect use of products exempted from the requirements of Directive 2004/42/EC would justify the additional administrative burden.

Assessment of Option D

1) Environment/health-oriented aim of the directives

Since 2004, new coatings with low VOC content have been developed for products regularly coated inside of installations but falling under the scope of Directive 2004/42/EC. This is the case for coatings used for building trims, fittings and associated structures, and in particular relevant for coatings designed for wooden floors and for wooden stairs. The introduction of the "in-situ" option would allow using any coatings in activities not covered by the national transposition of Directive 1999/13/EC. This will lead to higher VOC emissions than under the current legislation. The increase of emissions would be relevant in case of coatings used for objects covered by the current scope of Directive 2004/42/EC (building trims, their fittings and associated structures as well as certain vehicle repair activities). Therefore the introduction of the "in-situ" principle would contradict the environment/health-oriented aim of both directives.

2) Market-oriented aim of Directive 2004/42/EC

Manufacturers having introduced coatings in compliance with the requirements of Directive 2004/42/EC would loose a relevant market for coatings used inside of installations currently required to use products complying with Directive 2004/42/EC and in future potentially preferring the use of coatings with higher solvent content. A quantification of this market is difficult because it needs a specific data collection for coatings only used inside of installations. The introduction of the "in-situ" principle could increase misuse of coatings exempted from the requirements of Directive 2004/42/EC because all small workshops currently required to use products complying with Directive 2004/42/EC would easily have non-compliant product on hand when required to use compliant products for coating outside of the installation (e.g. for stairs coating).

3) Aim of clear regulations, facilitating easy understanding/implementation/ monitoring

An amendment of Directive 2004/42/EC extending the exemption under Article 3(2) to all activities under Annex I of Directive 1999/13/EC has the advantage that it would clearly separate the requirements on coatings used inside of installations from requirements on coatings used outside of installations ("in-situ"). This could ease implementation and monitoring inside installations. The introduction of the "in-situ" principle would lead to harmonised market sizes for products under the scope of Directive 2004/42/EC because non-compliant products could be used inside of installations independently from the activity's registration/authorisation and its compliance with Articles 3 and 4 of Directive 1999/13/EC.

Summary of assessment of options for the solvent consumption threshold case

Four options have been discussed to avoid ambiguity regarding requirements for installations carrying out activities with a solvent consumption below the thresholds set out in Annex IIA of Directive 1999/13/EC.

A. Option A has the advantage that it supports the aim of VOC reduction by giving clear provisions for installations with a solvent consumption below the thresholds set out in Annex IIA of Directive 1999/13/EC as well as for installations in Member States where lower national threshold values have been set. This solution does not create disincentive for lowering threshold values.

   However, the solution creates distortion of the market because products find different market sizes due to different setting of threshold values but it does not hinder the free circulation of products within the EU.

   To achieve clear and unambiguous understanding of the solution, the wording of the Commission's answer as well as the wording of Article 3(2) of Directive 2004/42/EC could be improved. The solution should be better communicated among authorities and stakeholders.

B. A strict interpretation of the exemption Article 3(2) of Directive 2004/42/EC would allow the use of exempted products only in installations exceeding the activity threshold set out by Annex IIA of Directive 1999/13/EC. Such an exemption would not be allowed for installations additionally brought under the scope by lowering the thresholds. Environmental benefit can result from the introduction of provisions for the coating of objects not under the scope of Directive 2004/42/EC. This way, a limited support of the aim of VOC reduction is achieved by this solution. It would create a harmonised market because conditions to use products complying/not-complying with Directive 2004/42/EC would be the same in the EU. The solution would provide clear regulations for installations with a solvent consumption below the thresholds set out by Directive 1999/13/EC.

On the other hand, the solution would discourage Member States lowering the threshold values because products complying with Directive 2004/42/EC would have to be used as they have to under the current legislation. The option would create additional monitoring problems in installations falling under the scope of a national threshold because for different objects different requirements apply depending on whether the objects are covered by scope of Directive 2004/42/EC or not.

C. The third solution comprises the introduction of a certificate for installations that are allowed to use products exempted from the VOC limit provisions of Directive 2004/42/EC. This solution could support the aim of VOC reduction as it enhances the correct use of exempted products.

   On the other hand, certificates would be needed also for activities coating objects not covered by Directive 2004/42/EC and therefore without VOC limitations. This would go along with a significant administrative burden and could end up in granting certificates to most of the installations because they carry out multiple activities. This would questions the positive effect of the certificate because it would not hinder the use of non-compliant products for the coating of objects under the scope of Directive 2004/42/EC.

D. The introduction of the "in-situ" principle would have the advantage to clearly distinguish the requirements for products used outside of installations and products used inside of installations. It would lead to harmonised market sizes for products covered by Directive 2004/42/EC regardless from different solvent consumption thresholds.

   On the other hand, the "in-situ" principle can increase VOC emissions in installations currently using products in compliance with Directive 2004/42/EC. Manufacturers having invested since 2004 in the development of low-solvent content coatings would loose their markets. This is relevant in particular for manufacturers of specific coatings used for wooden floors and stairs. The "in-situ" principle would increase the potential misuse of products not in compliance with Directive 2004/42/EC in case of workshops coatings both inside and outside of installations. Activities currently required to use compliant products for both, inside and outside coating, would have non-compliant products easy on hand for coating activities carried out outside of installations under the scope of Directive 2004/42/EC.

3.3.3. Multiple activities case

Background

Overlap problems have been reported from Member States and stakeholders arising from difficulties of monitoring the requirements in installations carrying out activities with obligatory use of products complying with Directive 2004/42/EC and also carrying out other activities where the use of such products is not obligatory. The scope of Directive 2004/42/EC is restricted to certain products used for particular purposes:

- Use of paints and varnishes (excluding aerosols) applied to **buildings, their trim and fittings, and associated structures** for decorative, functional and protective purpose. (Directive 2004/42/EC Annex I 1.1)
- Coating of road vehicles as defined in Directive 70/156/EEC (now Directive 2007/46/EC), or part of them, carried out as part of **vehicle repair, conservation or decoration outside of manufacturing installations**. (Directive 2004/42/EC Annex I 2.1)

Case A: Use of decorative coatings

Overlap problems have been reported e.g. in small carpenter workshops or small metal workshops having activities listed in Annex I of Directive 1999/13/EC but with a solvent consumption below the national solvent consumption threshold. These installations have to use products complying with Directive 2004/42/EC, but this is only obligatory for the coating of objects under the scope of Directive 2004/42/EC (like trims and fittings of buildings, and associated structures). Therefore, most of these workshops apply coatings also for objects not falling under the scope of Directive 2004/42/EC (e.g. for the coating of furniture or art work). Coatings used for these activities do not need to comply with requirements of Directive 2004/42/EC. Vice versa such products can easily be used incorrectly when coating objects under the scope of Directive 2004/42/EC. Monitoring and enforcement of correct use is difficult.

Case B: Use of vehicle refinishing products

Overlap has also been reported from vehicle refinishing activities. These activities are partly covered by Directive 2004/42/EC (e.g. repair of road vehicles as defined in Directive 70/156/EEC) and partly regulated under Directive 1999/13/EC (e.g. coating of trailers with vehicle refinishing products).

Trailer coating is exempted from using products complying with Directive 2004/42/EC if the activity is registered/authorised and operated in compliance with Directive 1999/13/EC.

In these installations products not complying with Directive 2004/42/EC are easily on hand to be used incorrectly for the coating of objects covered by the scope of Directive 2004/42/EC, like for vehicle repair.

In some cases, ambiguity has been reported on the question whether only original coating of trailers with vehicle refinishing products is covered by Directive 1999/13/EC.

Present solutions for the overlap problem

At present, Directive 2004/42/EC does not require monitoring of activities where the use of products complying with Directive 2004/42/EC is obligatory. Therefore it is difficult for authorities to avoid the incorrect use of non-complying products for objects under the scope. Some Member States have reported that they effectuate monitoring of the correct use of products based on chemicals regulation providing that chemicals are to be used according to the description on their technical data sheet.

In Germany, labels have been introduced declaring that certain coatings are designed "only for furniture coating". Denmark reported that some companies use labels stating that the products are "not for sale for the general public." [DK Quest, 2008]. Slovakia suggests obligatory labelling of all coatings which do not comply with Directive 2004/42/EC by indicating that the product is "only for use in installations according to Directive 1999/13/EC" [SK Quest, 2008].

Other potential solutions for the overlap problem

Possible solutions could be:

A. Extension of the scope of Directive 2004/42/EC to coatings used for other objects than currently under the scope.

B. Labelling the coatings stating the objects they are made for.

C. Monitoring the correct use of products under the scope of Directive 2004/42/EC

D. Amendment of Directive 1999/13/EC by explicitly stating that both trailer coating activities are covered by Directive 1999/13/EC: original coating of trailers and repair coating of trailers.

In the following section, the pros and cons of the solutions are being assessed. The pros and cons are evaluated by using the following criteria:

1) Qualification to reach the environment/health-oriented aim of VOC emission reduction (Recitals 7, 8, 9 and Article 1 of Directive 1999/13/EC; Recitals 3, 9 and Article 1 of Directive 2004/42/EC)
2) Qualification to reach the market-oriented aim of Directive 2004/42/EC: Avoid unnecessary barriers to trade and distortion of competition within the internal market. Ensure a free movement of goods by establishment of harmonised VOC limit values (Recitals 4, 5 of Directive 2004/42/EC).
3) Qualification to provide clear orientation for authorities and stakeholders in overlap cases, to ease monitoring/reduce administrative burden and to facilitate implementation by operators.

A) Extension of the scope

The problem under the current regulation is caused by different requirements for either using decorative coatings for objects under the scope of Directive 2004/42/EC or for using decorative coatings for objects not under the scope of Directive 2004/42/EC. This problem can be solved by an extension of the scope of Directive 2004/42/EC resulting in a scope covering coatings used for any object.

1) Environment/health-oriented aim of the directives

The extension of the scope of Directive 2004/42/EC to other objects than trims and fittings of buildings and their associated structures would reduce the overlap problem. Such an extension is assessed in chapter 11 on page 128 (option 8). The extension would support the directive's aim of VOC reduction if ambitious VOC limits are determined.

The extension would limit the VOC content of coatings where the content is currently not limited. This study includes an assessment of an extension of the scope of Directive 2004/42/EC for wood coatings covering all objects (see option 8). The assessment shows that a harmonised VOC limit approach for most wood coatings could be achieved. On the one hand harmonised limit values for wood coatings would avoid the misuse of products not complying with the limit values of Directive 2004/42/EC for objects under the current scope of the directive. On the other hand extending the scope of Directive 2004/42/EC may create new cases of overlap with Directive 1999/13/EC in activities currently not carrying out coating under the scope of Directive 2004/42/EC (e.g. furniture coating).

2) Market-oriented aim of Directive 2004/42/EC

The extension of the scope would create harmonised regulations in Europe and would avoid national approaches for setting lower product-related limit values as currently done e.g. in The Netherlands for workers health protection.

3) Aim of clear regulations, facilitating easy understanding/implementation/monitoring

An extension of the scope of Directive 2004/42/EC to coatings for objects currently not covered by the scope would facilitate easy understanding of the provisions by operators and authorities. At present the distinction of the objects falling under the scope and objects not falling under the scope is a major implementation problem (e.g. the question whether fixed furniture are fixtures of a building). A disadvantage of an extension of the scope is that an increased number of products would have to be monitored, increasing the administrative burden for authorities. The increase is expected to be small because the products categories would generally remain the same as the current ones. Another disadvantage is the additional burden to small and medium size enterprises (SME), implying the need for adaptation of their coating practices and procedures.

B) Labelling

This solution would introduce an obligation for labelling those products that are intentionally not complying with the provisions of Directive 2004/42/EC. The labelling would need to state the obligatory use of the coating for certain objects not covered by Directive 2004/42/EC (like boats, furniture, motorcycles) or the obligatory use in activities registered/authorised and in line with the provisions of Articles 3 and 4 of Directive 1999/13/EC. From the legal point of view it has to be assessed whether such a labelling provision can be included in Directive 2004/42/EC if no VOC limits have been set for this product group.

1) Environment/health-oriented aim of the directives

The solution would support the aim of VOC reduction because it would enhance the correct use of products exempted from the provisions of Directive 2004/42/EC and of products not covered by the scope of Directive 2004/42/EC.

2) Market-oriented aim of Directive 2004/42/E:

The solution has no influence on a harmonised market and free movement of goods.

3) Aim of clear regulations, facilitating easy understanding/implementation/monitoring

Labelling of products would ease implementation and monitoring of Directive 2004/42/EC because it would give clear orientation to users about the activities the coating is allowed to be used for.

The disadvantage of the solution is an increased cost for coating manufacturers for design and fixing of the new product labels.

<u>C) Monitoring of the correct use of products under the scope of Directive 2004/42/EC</u>

Occasional monitoring of installations could be carried out in activities with vehicle refinishing products partly under the scope of Directive 2004/42/EC and partly allowed to use non-compliant products under Directive 1999/13/EC. The monitoring of the correct use of products under the scope of Directive 2004/42/EC could be based on chemicals regulations. The monitoring could establish rules with the operator defining all relevant coating activities and determining the types of coatings used respectively allowed for these activities.

1) Environment/health-oriented aim of the directives

An occasional monitoring of installations carrying out both activities, those under the scope and those out of the scope of Directive 2004/42/EC, is not seen as effective. On the one hand a high number of small workshops is affected and on the other hand coating is often done irregularly and therefore difficult to monitor by authorities.

However, if installations carry out activities under the scope of Directive 1999/13/EC and also activities under the scope of Directive 2004/42/EC, it is considered as effective to realise an occasional monitoring. On the one hand a relatively small number of installations is affected. On the other hand coating is done regularly and therefore possible to be monitored by authorities.

Authorities can require a clear description of all coating activities of the installation and the related use of products to agree with the operator on clear rules for all activities and related types of coating. A clear indication of products intentionally not complying with Directive 2004/42/EC can ease monitoring.

This proceeding can have positive effects on the aim of VOC reduction because the correct use of products exempted from the provisions of Directive 2004/42/EC is enhanced.

2) Market-oriented aim of Directive 2004/42/E:

The solution has no influence on a harmonised market and free movement of goods.

3) Aim of clear regulations, facilitating easy understanding/implementation/monitoring

Recommending an occasional monitoring of installations is not a clear provision. Its execution depends on the local capacity of the authority and on priorities of the monitoring plan. The measure can only be regarded as an advice for local authorities to minimise overlap problems in such installations.

<u>D) Amendment of Directive 1999/13/EC</u>

The wording of Directive 1999/13/EC could be changed by clarifying that the use of vehicle refinishing products for the original coating of trailers and for the repair coating of trailers is both covered by Directive 1999/13/EC.

1) Environment/health-oriented aim of the directives

The clarification can lead to more VOC reduction bringing all activities unambiguously under the provisions of Directive 1999/13/EC.

2) Market-oriented aim of Directive 2004/42/E:

The solution would harmonise the market because it would establish same conditions in all Member States.

3) Aim of clear regulations, facilitating easy understanding/implementation/monitoring

A change of wording of Directive 1999/13/EC would improve clarity, explicitly expressing that repair and original coating of trailers is under its scope. No disadvantages are expected.

Summary of solutions for the multi-activity case

Four options have been discussed above for typical overlap problems in multi-activity installations.

A. Extension of the scope of Directive 2004/42/EC to other objects than trims and fittings of buildings and their associated structures (see option 8). The extension would lead to additional VOC reduction if ambitious VOC limits would be determined. The extension has the potential to reduce the incorrect use of products exempted from the requirements of Directive 2004/42/EC. Distortions of the market caused by Member States setting lower national VOC limit values (e.g. for workers health protection) would be avoided. Implementation would be easier because the question of correct attribution of objects to the scope of Directive 2004/42/EC would be minimised.

   The disadvantage of the extension of the scope of Directive 2004/42/EC is an additional burden for small and medium sized enterprises required to adapt their coating procedures.

B. The introduction of an obligatory labelling of products intentionally not complying with Directive 2004/42/EC would state the obligatory use of the coatings for certain objects not covered by Directive 2004/42/EC (like boats, furniture, motorcycles) or the obligatory use in activities registered/authorised and in line with Articles 3 and 4 of Directive 1999/13/EC. The solution would enhance the correct use of coating products without VOC limits. It would ease implementation but it would also lead to additional labelling cost for manufacturers.

   From a legal point of view it is not clear whether the introduction of such a labelling requirement is possible to include in Directive 2004/42/EC although for these products no VOC limits are provided in the directive.

C. The introduction of an occasional monitoring of installations carrying out activities with vehicle refinishing products would improve the correct use of coatings exempted from the requirements of Directive 2004/42/EC in activities partly allowed to use non-compliant products (under Directive 1999/13/EC or without falling under the scope of the directives).

   The solution has the character of a recommendation to competent authorities because it needs to be realised under the monitoring of chemicals regulations and cannot be included in Directive 2004/42/EC.

D. An amendment of Directive 1999/13/EC could clarify that the use of vehicle refinishing products for the original coating of trailers and for the repair coating of trailers are both covered by Directive 1999/13/EC. This would harmonise the markets. It would improve clarity and would bring all activities unambiguously under the provisions of Directive 1999/13/EC.

3.4. Monitoring of the Directive 2004/42/EC

The Commission's questionnaire on the first phase of implementation of Directive 2004/42/EC [COM 2007c] included an optional request for sending in written monitoring programmes. The project team has studied and compared 12 monitoring programmes which have been sent to the Commission in written form.

3.4.1. Aims of monitoring and current deficits of operationalisation

An effective written monitoring programme should be comprehensive and easy to understand, providing best evidence on compliance of Directive 2004/42/EC, achieved with reasonable effort.

Based on the evaluation of 12 monitoring programmes, the project team has developed elements that can support the writing of a detailed monitoring programme. The following elements are considered as essentials to be described in the programme:

- Preparation: Description of the target groups of the data base
- Preparation: Description of compilation of the data base
- Administration: Definition of responsible persons and authorities
- Administration: Definition of reporting requirements (formats etc.)
- Strategy: Definition of priority target groups
- Strategy: Definition of priority product groups
- Strategy: Definition whether labelling or/and VOC content is monitored
- Strategy: Definition of the monitoring method (intervals, selection of monitoring subjects by market share, etc.)
- Strategy: Definition of sampling strategy (amount, random)
- Strategy: Definition of labelling compliance check
- Strategy: Definition of VOC content compliance check
- Execution: Definition of responsible person for sample taking (authority, consultant, manufacturer)
- Execution: Definition of procedure of sample taking (with/without announcement, reporting)
- Wording: Precise, detailed enough to avoid uncertainties

An evaluation has been made for monitoring programmes delivered by some Member States to the Commission together with the regular reporting on Directive 2004/42/EC in July 2008 (see annex 22 on page A-283)

Proposals for three levels of ambition for monitoring programmes have be developed and included in annex **Fehler! Verweisquelle konnte nicht gefunden werden.** on page A-**Fehler! Textmarke nicht definiert.**.

3.5. Estimation of VOC emissions

The project team assessed the development of the decorative paints and vehicle refinishing market and related VOC emissions use of decorative paints and vehicle refinishing products in a scenario based on existing regulations as defined by Directive 2004/42 without implementation of new VOC limit values.

Data used for the estimations was provided by CEPE and covers all the product categories as defined by Directive 2004/42/EC. Furthermore, data on quantity in tonnes and 1000 litres has been provided. Current VOC emissions have been estimated based on VOC contents for the years 2003 and 2006 for decorative coatings and 2003 to 2007 for vehicle refinishing products.

As data was available for two different years, it was possible to estimate a growth rate which was used for the extrapolation of data into the years 2010, 2015 and 2020. This growth rate was calculated based on the concept of the compound annual growth rate (CAGR) which assumes a constant growth rate for a certain period of time based on the first and the last value. The formula for the CAGR is as follows:

$$\text{CAGR} = \left(\frac{end\ value}{begin\ value} \right)^{\frac{1}{\#\,of\ \ years}} - 1$$

The concept of the CAGR was also applied in the extrapolations of data for some of the proposed regulatory measures discussed further below in this study. In the current case, the CAGR was estimated for each product category provided by CEPE. As the CEPE table defines different categories than Directive 2004/42/EC and merges certain categories for decorative coatings and the merging of certain categories into one CEPE category, the following table presents the different categories in order to identify difficulties in the estimations.

Table 9: Comparison of categories from CEPE and Directive 2004/42

CEPE categories	Categories of Directive 2004/42
Interior wall and ceilings paints (cat. 1)	a) Interior matt walls and ceilings (Gloss <25@60°) b) Interior glossy walls and ceilings (Gloss >25@60°)
Exterior wall paints (cat. 2)	c) Exterior walls of mineral substrate
Pigmented opaque trim paints for wood and metal (plastic), including wooden cladding (cat. 3)	d) Interior/exterior trim and cladding paints for wood and metal
Clear coatings, varnishes, wood stains and lasures (cat. 4 and 5)	e) Interior/exterior trim varnishes and woodstains, including opaque woodstains f) I nterior and exterior minimal build woodstains
Other decorative coatings (cat. 6, 7, 8, 9, 10 and 11)	g) Primers h) Binding primers i) One-pack performance coatings j) Two-pack reactive performance coatings for specific end use such as floors k) Multi-coloured coatings l) Decorative effect coatings

As can be seen from the table, CEPE has summarised categories g) to l) into one category. Furthermore, CEPE provided a single value for the VOC content for water-based as well as for solvent-based products. This value was assumed to remain unchanged for the time period covered, as the project team could not derive a new value for this summarised category.

The resulting total VOC emission from all categories for the EU-27 Member States plus Croatia and Turkey are summarised in Table 10 and Table 11.

Table 10 shows a decrease in VOC emissions from 2003 to 2006, continuing to decline after the implementation of phase II VOC limit values from Directive 2004/42 in 2010. For 2015 and 2020, the VOC emissions increase as a result of the positive growth rate for water-based products.

Table 10: Total VOC emissions from decorative paints per country in EU-27+2

Country	2003 kt	2006 kt	2010 kt	2015 kt	2020 kt
Austria	5.05	5.19	4.85	5.23	5.76
Belgium	9.90	7.95	7.39	7.64	8.07
Bulgaria	1.58	1.59	1.29	1.45	1.68
Cyprus	10.73	8.57	7.08	8.15	9.66
Czech Republic	7.21	7.16	5.80	6.54	7.56
Denmark	5.19	4.50	3.93	4.16	4.50
Estonia	0.77	0.83	0.67	0.75	0.87
Finland	5.92	3.86	3.08	3.25	3.48
France	56.98	65.36	49.30	58.92	73.00
Germany	71.27	60.07	60.17	70.27	83.64
Greece	12.09	12.00	10.04	10.65	11.51
Hungary	9.45	7.80	6.59	7.08	7.76
Ireland	4.74	5.00	4.04	4.37	4.81
Italy	54.17	45.95	39.67	42.22	46.12
Latvia	0.89	1.01	0.82	0.92	1.07
Lithuania	1.47	1.51	1.23	1.38	1.60
Luxemburg	0.00	0.00	0.00	0.00	0.00
Malta	0.39	0.32	0.26	0.29	0.34
Netherlands	18.98	13.03	11.48	12.63	14.16
Poland	48.23	18.42	29.51	31.04	33.16
Portugal	15.45	12.18	12.22	14.12	16.84
Romania	4.68	6.17	4.99	5.63	6.52
Slovakia	4.67	3.02	2.55	2.57	2.63
Slovenia	2.29	1.96	1.58	1.79	2.07
Spain	60.63	56.89	48.90	52.85	58.39
Sweden	12.70	10.54	9.75	10.80	12.14
UK	60.26	48.69	46.05	48.93	52.82
EU-27	485.71	409.58	373.25	413.67	470.14
Croatia	2.67	2.47	2.00	2.25	2.61
Turkey	23.90	26.47	21.42	24.15	27.95
EU-27+2	512.28	438.52	396.67	440.07	500.7

With respect to vehicle refinishing products, Table 11 shows a decrease in VOC emissions from 2003 to 2007. However, data from 2010 onwards show an increase in VOC emissions resulting from the positive growth rates estimated applying the above-mentioned formula.

Table 11: Total VOC emissions for vehicle refinishers per country

country	2003 kt	2007 kt	2010 kt	2015 kt	2020 kt
Austria	2.20	1.75	1.59	1.47	1.47
Belgium and Luxemburg	2.44	2.25	2.17	2.08	2.03
Bulgaria	0.11	0.13	0.13	0.13	0.13
Czech Republic	0.49	0.58	0.57	0.56	0.56
Denmark	1.19	1.03	0.99	0.99	1.04
Estonia	0.05	0.07	0.07	0.07	0.07
Finland	0.83	0.61	0.54	0.47	0.42
France	7.44	5.97	5.41	4.70	4.17
Germany	12.30	10.67	10.06	9.26	8.67
Greece and Cyprus	1.07	1.02	1.06	1.18	1.38
Hungary	0.45	0.46	0.45	0.44	0.45
Ireland	0.51	0.58	0.68	0.90	1.27
Italy and Malta	9.59	8.85	9.15	10.39	12.65
Latvia	0.06	0.10	0.09	0.09	0.09
Lithuania	0.10	0.13	0.13	0.12	0.13
Netherlands	3.32	3.85	3.71	3.71	3.91
Poland	1.15	1.42	1.39	1.36	1.37
Portugal	1.55	1.29	1.24	1.22	1.27
Romania	0.32	0.56	0.55	0.54	0.55
Slovakia	0.18	0.25	0.24	0.24	0.24
Slovenia	0.15	0.16	0.15	0.15	0.15
Spain	7.36	6.79	6.70	6.60	6.57
Sweden	1.31	1.56	2.05	3.60	6.82
UK	6.68	6.27	6.23	6.32	6.54
EU-27	60.85	56.35	55.35	56.58	61.93
Croatia	0.18	0.20	0.19	0.19	0.19
Turkey	1.62	2.15	2.11	2.07	2.08

4. Options assessed for potential amendment of Directive 2004/42/EC aiming at improved legislation and at additional VOC reduction

4.1. Overview on options assessed

4.1.1. Assessments during the first project phase

During the first project phase, until November 2008, the consortium has collected information on the question whether VOC limits currently defined by Directive 2004/42/EC are feasible, challenging or could be lowered. Table 12 shows an overview of all issues assessed.

For decorative coatings, Directive 2004/42/EC forsees that stricter limits will come in force from 1.1.2010 on; information has been collected with regard to the new limits, accordingly.

For vehicle refinishing products no stricter limits have been defined in the Directive; the focus of the evaluation was on the potential for setting stricter VOC limits in future.

While the scope of Directive 2004/42/EC covers aerosol-type products for vehicle refinishing, such aerosol-type decorative coatings used for the building sector are excluded from the scope (so-called "non-automotive aerosols"). Following the request in article 9 (1b) of the directive, the project team has evaluated possibilities to include these aerosol-type coatings into the scope of the directive.

Table 12: Overview on assessments of the first project phase

Title of assessment	Activity in first project phase	More information to be found
Evaluation of suitability of VOC limits for decorative coatings and of the potential for stricter VOC limits	Information collection	Chapter 4.2, p. 83
Evaluation of suitability of VOC limits for vehicle refinishing coatings and potential for stricter VOC limits	Information collection	Chapter 4.3, p. 86
Inclusion of aerosol-type 'non-automotive' coatings	Information collection	Chapter 4.4, p. 88

The evaluation of potential stricter VOC limits for decorative coatings is described in chapter 4.2. It derived in the proposal of options 4 (stricter limits for interior paints). Results of the impact assessment for this option are summarised in chapter 7 (page 107).

The evaluation of potential stricter VOC limits for vehicle refinishing coatings is described in chapter 4.3. It derived in the proposal of option 2 (on water-based basecoats in 2-stage topcoat systems). new limit value for basecoat topcoats in the category B (d) 'topcoat') and in the proposal for option 3 (shift of subtypes of coatings currently classified as 'special finishes' into existing categories with stricter limit values). Results of the impact assessment for both options are summarised in chapter 6 (page 98).

The evaluation of an inclusion of aerosol-type 'non-automotive' aerosol coatings is described in chapter 4.4. It concluded that an inclusion of these aerosols would lead to increased monitoring effort although the VOC reduction potential would be relatively high while the monitoring efforts and related costs would be high because of a high variety of product groupsis very limited. Therefore this option has not been further assessed.

4.1.2. Assessments during the second project phase

In November 2008, the project team has proposed to the Commission several options for further assessment, documented in the draft Interim Report of 21.11.2009. These options have been selected after the first project phase because they are showing a potential for improvement of the current legislation, or show a potential for further VOC reduction - under the current scope or by extension of the scope of Directive 2004/42/EC.

The final version of the Interim Report was made available to Member States and stakeholders on 16.02.2009, informing about the options for further assessment that had been agreed with the Commission Services (Table 13).
The report specified whether a complete impact assessment was planned or whether further information collection was necessary. Table 13 gives an overview on the agreed options and specifies where more information can be found.

Table 13: Overview on options for further assessment resulting from the first project phase

Number of option and title of assessment	Activity in second project phase	More information to be found in
1 Improvement of definitions	Information collection	Chapter 5, p. 95
2 New VOC limit within an existing vehicle refinishing group	Impact Assessment	Chapter 6, p. 98; annex 4, p.41
3 New allocation of vehicle refinishing product groups		
4 New VOC limit values for interior use of decorative paints in categories d), e) and f)	Impact Assessment	Chapter 7, p. 107; annex 5, p. 55
5 Update of ISO test method	Information collection	

Number of option and title of assessment	Activity in second project phase	More information to be found in
6 Inclusion of additional ISO test method	Information collection	Chapter 8, p. 114
7 Inclusion of measuring method description	Information collection	
8 Extension of the scope covering coatings for all wooden objects	Impact Assessment	Chapter 11, p. 128; annex 7, p. 79
9 Extension of the scope covering protective coatings	Impact assessment	Chapter 12, p. 134; annex 6, p. 73
10 Extension of the scope covering motorcycle coatings	Information collection	Chapter 10, p. 126
11 Extension of the scope covering solvent-based floor covering adhesives	Impact assessment	Chapter 13, p.143; annex 12, p. 135
12 Extension of the scope covering cosmetic products a) deodorants/antiperspirants, b) hairsprays, c) labelling of VOC content of deodorants/antiperspirants and hairsprays	Impact assessment	Chapter 14, p. 151; Chapter 15, p. 162; Chapter 16, p. 169; annex 13, p. 151
13 Extension of the scope covering glass window cleaners	Impact Assessment	Chapter 17, p. 174; annex 16, p. 221
14 Extension of the scope covering aerosol-type insecticides	Information collection	Chapter 18, p. 180
15 Extension of the scope covering marine coatings	Information collection	Chapter 19, p. 184
16 Extension of the scope covering road markings	Information collection	Chapter 20, p. 187
17 Extension of the scope covering impregnating products	Information collection	Chapter 21, p. 191

Detailed information on the options was given to stakeholders and Member States in the introduction of the questionnaires used for consulting on expected impacts of each option, and on request.

No complete impact assessment was undertaken in cases where options were not expected to have major impact (option 1 on improvements of definitions, options 5-7 on analysis methods, and option 10 on explicit inclusion of motorcycle coatings into the scope of Directive 2004/42/EC).

No complete impact assessment but only compilation of information was done if information collection showed that the potential for VOC reduction is low due to small volumes of the product group or limited possibilities to achieve same product quality with low-VOC or no-VOC products (option 15 on marine coatings and option 17 on water-repellent impregnation products).

No complete impact assessment was possible for road markings because information collection on coating systems and reduction potential was more difficult due to the lack of a European-wide stakeholder organisation. However, when more data had been gathered, the results showed that there is a relevant potential for VOC reduction and technical alternatives seem to be feasible. Due to the timeline of the project it was not possible to start a complete impact assessment on an option setting limit values for complete substitution of solvent-based road markings. For detailed information on road marking coating systems and VOC reduction options see annex 17 on page 235; a summary can be found in chapter 20 on page 187 (option 16).

4.2. Evaluation of current categories and VOC limits for decorative coatings

The project team has assessed current categories and VOC limits for decorative coatings by consultation of industry and Member States. The feedback is reported in annex 1 on page A-2. The paint manufacturers' position paper by CEPE [CEPE, 2008d] can be found in annex 30, a response of professional painters by UNIEP [UNIEP, 2009] is documented in annex 31.

CEPE and UNIEP give their rational, proposing to require no further VOC-reduction beyond the 2010 limits for decorative paints and varnishes.

Largely, the project team supports the general conclusion that
"*the 2010 VOC ceilings for Decorative Paints and Varnishes (…) represent the practical limit of what is technically feasible without compromising quality and choice across the EU. More stringent limits would impact on practical workability and/or film performance and appearance*." [CEPE, 2008d]

However, in certain categories reduction options may be feasible – although only partly considered as appropriate within the current revision process. Partly a reduction potential is expected to be feasible in the future revision processes (Article 9.2 of Directive 2004/42/EC foreseens the 2nd reporting for June 2012).

The following chapters provide an assessment of each of the categories of decorative paints according to Annex II A of Directive 2004/42/EC.

4.2.1. Category a) - Interior matt walls and ceilings

The project team considerates the VOC limit of 30 g/l determined for phase II as low and as difficult to reduce.

4.2.2. Category b) - Interior glossy walls and ceilings

The VOC limit determined for phase II is 100 g/l. The project team has noticed that the national Dutch limit value for all interior wall paints is 60 g/l. However, customer demands regarding 'glossiness' of wall paints differ across the EU, which is regarded as justification a slightly higher limit.

4.2.3. Category c) - Exterior walls of mineral substrate – water-based

The project team acknowledges that the limit of 40 g/l is low and difficult to reduce.

4.2.4. Category c) - Exterior walls of mineral substrate – solvent-based

The project team agrees with industry that it is likely that for high demanding purposes (poor masonry, high humidity circumstances) the VOC limit of 430 g/l determined for phase II is needed.

However, the opportunity is given to use these high-VOC exterior wall coatings in less-demanding applications as well. A distinction may be feasible if the paint would be linked to its conditions of use (difficult to implement because linking the use of a coating to climatical conditions is difficult and complex to monitor).

4.2.5. Category d) - Interior/exterior trim and cladding paints for wood and metal – water-based

The limit set by Directive 2004/42/EC for phase II is 130 g/l. However, the national Dutch limit for *interior* applications is 100 g/l. Under the current definition, the limit has to cover both interior and exterior applications and seems justified for this purpose.

During the second project phase, an impact assessment has been undertaken to evaluate the option defining separate limit values for interior and exterior coatings (Option 4), see chapter 7 on page 107 and related annex 5 page A-55.

4.2.6. Category d) - Interior/exterior trim and cladding paints for wood and metal – solvent-based

The project team agrees that the current limit of 300 g/l seems close to the lowest limit currently achievable for solvent-based products, if exterior applications have to be covered as well.

Another option, proposed by Sweden, is to distinguish subcategories for interior and exterior applications. National regulations exist in Sweden and also in the Netherlands. This option may result in additional VOC reduction, as described in chapter 3.1.3. A related impact assessment has been undertaken (Option 4). It is summarised in chapter 7; details can be found in annex 5 on page A-55.

4.2.7. Category e) - Interior/exterior trim varnishes and woodstains, including opaque woodstains – water-based and solvent-based

The project team acknowledges that the current limits of 130 g/l for water-based and 400 g/l for solvent-based products are demanding. However, a similar option as described for category d), to distinguish subcategories for interior and exterior applications, can lead to additional VOC reduction because for interior use water-based products have sufficient quality and performance.

The related impact assessment (Option 4) is summarised in chapter 7; details can be found in annex 5 on page A-55.

4.2.8. Categories f) - Interior and exterior minimal build woodstains;

The limit of 130 g/l for the water-based varieties is regarded as sufficiently low.

The limit of 700 g/l for the solvent-based variety is rather high but the project team does not provide of information justifying lower limits in case of exterior use. For interior use, the limit could be lowered due to lower product requirements, which can be achieved with water-based products.

Separate VOC limits for interior and exterior use can lead to some additional VOC reduction, although market volumes are expected to be small. The related impact assessment (Option 4) is summarised in chapter 7; details can be found in annex 5 on page A-55.

4.2.9. Categories g) – Primers; h) – Binding primers

Although the current limits for these solvent-based varieties are rather high – in particular the limit of 700 g/l for category h) - the project team does not provide of information justifying lower limits. However, the volumes used are low compared to categories a) through d). The limits for the water-based varieties of 30 g/l are regarded as sufficiently low and difficult to reduce further.

4.2.10. Categories i) - One-pack performance coatings; j) - Two-pack reactive performance coatings for specific end use such as floors

According to CEPE, the limit values for solvent-based products of 600 g/l and 550 g/l should be maintained. The project team has noticed that also for these categories Dutch national regulations on interior applications have set a limit at 100 g/l, including applications with high demands such as wooden flooring (parquet). Therefore, the option to separate interior and exterior applications, as described in chapter 4.2.6 can lead to further VOC reduction.

The same option exists for two-pack flooring materials to apply over cement flooring (e.g. epoxy floors), which are practically always solvent-free already.

4.2.11. Categories k) - Multi-coloured coatings; l) - Decorative effect coatings

The project team agrees with CEPE that these categories involve low volume products and already need to comply with low values of 100 g/l respectively 200 g/l by 1.1.2010. Pushing towards lower limits is regarded as not cost effective.

4.2.12. Summary on stricter VOC limits for decorative paints

Table 14: Summary on stricter VOC limits for decorative paints

Category		Evaluation of VOC limit	Proposal
a Interior matt walls and ceilings (Gloss <25@60°)	WB/ SB	30 g/l is low and difficult to reduce	no change
b Interior glossy walls and ceilings (Gloss >25@60°)	WB/ SB	60 g/l instead of 100 g/l in NL, but for high gloss100 g/l seems necessary	revise in future
c Exterior walls of mineral substrate	WB	40 g/l is low and difficult to reduce	no change
	SB	430 g/l is needed for high demanding purposes. Link to usage is difficult.	no change
d Interior/exterior trim and cladding paints for wood and metal including opaque woodstains	WB	100 g/l for interior paints in NL instead of 130 g/l. May be feasible and assessed in future. First to separate limits for interior and exterior paints.	Change. See assessment in option 4
	SB	300 g/l is low for exterior use but not for interior use (could be 100-130 g/l). Introduce exterior and interior limits.	Change. See assessment in option 4
e Interior/exterior trim varnishes and woodstains, including opaque woodstains	WB	100 g/l for interior paints in NL instead of 130 g/l. May be feasible and assessed in future. First to separate limits for interior and exterior paints.	Change. See assessment in option 4
e Interior/exterior trim varnishes and woodstains, including opaque woodstains	SB	400 g/l is low for exterior use but not for interior use (could be 100-130 g/l). Introduce exterior and interior limits.	Change. See assessment in option 4
f Interior and exterior minimal build woodstains	WB	130 g/l for interior woodstains in NL instead of 130 g/l. May be feasible and assessed in future. First to separate limits for interior and exterior paints.	Change. See assessment in option 4
	SB	700 g/l is not adequate for interior use (could be 100-130 g/l). Introduce separate exterior and interior limits.	Change. See assessment in option 4
g Primers h Binding primers	WB/ SB	No information on feasibility of lower limits; considered as less relevant due to small total sales amount	no change
i One-pack performance coatings j Two-pack reactive performance coatings for specific end use such as floors	WB/ SB	100 g/l required for interior use in NL instead of 140 g/l and 500 g/l. Separate limits may be considered.	Revise in future
k Multi-coloured coatings l Decorative effect coatings	WB/ SB	Less relevant: small total quantities	no change
WB: Water-based, SB: Solvent-based			

4.3. Evaluation of existing categories and VOC limits for vehicle refinishing products

Existing categories and VOC limits have been discussed with CEPE and with product users (see CEPE position in annex 32 and AIRC interviews in annexes 34 and 35). Current limit values for vehicle refinishing products are listed in annex II of Directive 2004/42/EC.

The VOC limit values are expressed in g/l of the 'ready for use' product. Before determination of the VOC content, any water content of the product 'ready for use' has to be discounted, except for subcategory (a).

4.3.1. Category (a) - Preparatory and cleaning

The VOC limit for preparatory products is 850 g/l, for pre-cleaners 200 g/l. The project team has realised some development towards a wider use of water-based degreasers, in e.g. the Netherlands [De Haan, 2007], but noticed that this is not EU-wide state of the art yet. A comprehensive overview on metal degreasing (including low-/no-VOC degreasing) has been collected as database by the European "Cleantool Project", published on http://www.cleantool.org

A general applicability of water-based degreasers could not be confirmed; therefore it is proposed to keep the VOC limit values unchanged.

4.3.2. Category (b) – Bodyfiller/stopper

The VOC limit for bodyfiller/stopper is 250 g/l. CEPE stated that actual VOC contents are well below 250 g/l, meaning that reduction of the VOC limit would be feasible. Nevertheless, the project team realised that no test method is available to accurately measure VOC emissions from polyester putties (see chapter 3.2).

As long as no test method is available for polyester putties, it is not possible to assess the VOC reduction potential of a lowered VOC limit for bodyfillers and stoppers. If not appropriate testing can be done, lowering the VOC limit value would have no consequences in practice and is therefore not proposed.

It has to considered that the VOC content of these materials will react within the material, and will evaporate only to a very minor extend.

4.3.3. Category (c) – Primer-surfacer/filler and general (metal) primer

The VOC limit for surfacer/filler and general (metal) primer is 540 g/l. The project team has noticed that primers with less than 250 g/l are available as general metal primers, but these are not specifically suitable for vehicle refinishing applications. Problems are the compatibility with other coatings and their ´filling´ capability.

There has been no notable development since 2003, and only a small VOC emission reduction of a few percent might be possible by setting a lower limit.

As no significant development on these primers could be identified, setting a lower limit value is currently not recommended.

4.3.4. Category (c) – Wash primer

The VOC limit for wash primers is 780 g/l.

The project team noticed that in the background study for Directive 2004/42/EC a VOC limit of 650 g/l was proposed for this product group, which is 17 % below the actual limit, but the study gave no rationale [EC, 2000].

CEPE stated that the current limit is needed in order to achieve excellent adhesion and thin films. CEPE estimates that the total volume of wash primer is small; detailed sales data could not be provided.

Due to lack of information it was not possible to assess whether the VOC reduction potential would be achievable and relevant in terms of volume.

4.3.5. Category (d) – Topcoat

The VOC limit for all kind of topcoats is 420 g/l.

The project team noticed that topcoats can be separated into three sub-groups:

- 1-layer system topcoats,
- 2-layer system base coats and
- 2-layer system clearcoats.

The project team concluded to assess the possibilities for changing the current prescription of calculating the VOC content without water by referring the VOC content to the total product. At the same time low VOC limits could be introduced for the 1-layer system that implies the use of water-based systems.

Furthermore, different VOC limits for base coat and clearcoat in 2-layer systems can be introduced implying the use of water-based base coats.

For this proposal an impact assessment has been done (**Options 2**). Results are summarised in chapter 6.2.1 on page 99; the complete impact assessment is documented in annex 4 on page A-41.

4.3.6. Category (e) – Special finishes

The project team has discussed with industry the opportunities to reduce VOC in this category and to avoid misunderstandings regarding classification.

The option that was identified is to change category definitions and to re-define the category e) 'Special products' by introducing a split into two subcategories. One group is proposed to be defined with a lower limit of 540 g/l while the other group remains under the current limit value of 840 g/l.

For this proposal an impact assessment has been achieved (**Options 3**). Results are summarised in chapter 6.2.2 on page 100; the complete impact assessment is documented in combination with option 2 in annex 4 on page A-41.

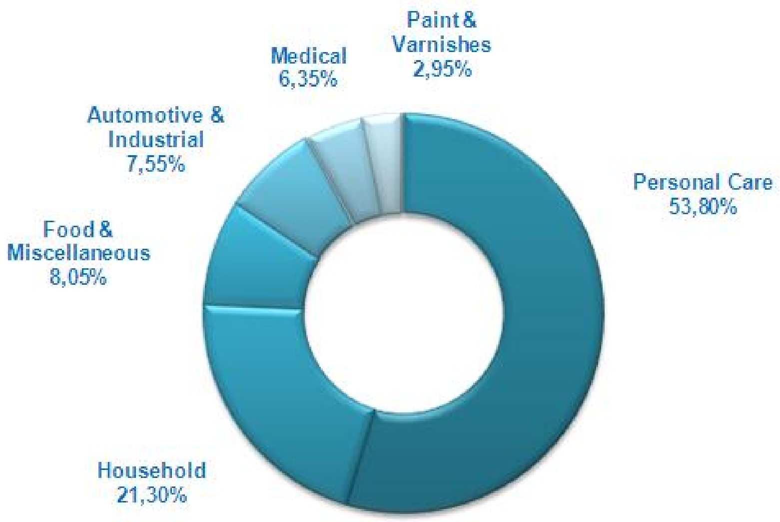
4.4. Assessment of potential scope extension covering aerosol-type decorative coatings

‘Aerosols for paints in varnishes’ are paints and varnishes that are supplied in spray-cans. Whereas Directive 2004/42/EC covers aerosol-type vehicle refinishing coatings, aerosol-type decorative coatings are not covered. Article 9 of the directive foresees that the directive's review report should evaluate whether the product group 'aerosols for paints and varnishes' can be included into the scope of the directive.

Major sources of information in this chapter comprise internet sites of manufacturers, literature, and two 'briefing papers' that were developed by a working group of CEPE and FEA (see annex 37) [CEPE/FEA, 2008-1], [CEPE/FEA, 2008-2]. The position was discussed on a meeting with CEPE and FEA on 05/09/2008.

4.4.1. Description of the product group

Figure 9 shows European aerosol production share for different sectors.



[FEA, 2008]

Figure 9: European Aerosol Production Share in 2007

Annex I (2) of Directive 2004/42/EC covers aerosols for paints and varnishes used for vehicle refinishing (automotive sector). Therefore, in the paint sector the remaining aerosols for paints and varnishes had to be assessed as potential candidates for scope extension. These paints and varnishes aerosols are called 'non-automotive' aerosols. CEPE/FEA define 'non-automotive' paint aerosols as follows:

"Non-automotive aerosols containing paints and varnishes used to decorate and/or protect furniture, accessories, radiators and appliances."

This group of paint aerosols includes sub-categories like primers, metallic and non-metallic topcoats, glitter sprays, fluorescents, hammer finishes, chrome-effects, clear varnishes etc. A short internet survey of products offered by three major manufacturers (Motip Dupli, Rust Oleum, Den Braven) has shown that there is a large product variety. At least 40 product types could be distinguished, ranging from anticorrosion primers for metal parts, to topcoats that are marketed for application on various substrates, e.g. wood, glass, plastic and metal.

'Non-automotive' aerosol paints are formulated to deliver an even coating that dries quickly to leave a smooth finish. These coating systems need to be dissolved in a 'carrier solvent' for their application. These carrier solvents, e.g. acetone, need to be quickly drying and have to be compatible with both paint resins and propellants (i.e. the liquefied gases that enable spray application, mainly propan/butan or dimethyl ether).

VOC contents stated in the technical documentation of manufacturers ranged from 436 g/l to 890 g/l. Specified VOC emissions per m^2 of substrate covered (depending on the spreading rate and coverage) ranged from 41 to 280 g/m^2. CEPE/FEA have questioned the lower end of the VOC content range, stressing that typical VOC contents of products that are in scope of the above definition range from **520 to 840 g/l** [CEPE/FEA, 2008-1] [CEPE/FEA, 2008-2].

Common binders of non-automotive aerosols for paints are one-pack acrylic, nitrocellulose and alkyd resins, and combinations of these.

The non-automotive aerosol paint industry sector is characterised by paint manufacturers ('fillers') who are SMEs. Those small companies have no or low export outside European Union [CEPE/FEA, 2008].

4.4.2. VOC emissions due to aerosols for paints and varnishes

CEPE and FEA arrived at an estimated VOC emission of 'non-automotive' paint aerosols in Europe of **19.7 kt** per annum (2007 figures). The following summary of the calculation method and the assumptions was provided to the consultants:

"On a confidential base, major producers provided their EU production figures (number of aerosols / units) for automotive and non-automotive paint aerosols.

An average density and an average VOC content have been agreed (expert judgment). Additionally, the figures have been split into three different nominal volumes. The collected data has been extrapolated with the production figures (number of aerosols / units) from the FEA statistics. The VOC estimated emissions for non-automotive paint aerosols (2007 figures) is 19.7 kt. Based on historical production figures (units), VOC emissions of paint aerosols for 2010 and 2020 were estimated to **21.1 kt** and **25.5 kt**." [D'Haese, 2008a]

The relative shares of automotive and non-automotive aerosols for paints were reported to be close to 50 % each.

Based on this CEPE/FEA information, VOC emissions due to the use of "non-automotive" aerosol paints are relatively small. They contribute with about 0.7% to total VOC emissions (9,391 ktons in 2006 [EEA, 2008a]), and with about

about **1.7%** to VOC emissions from paints (category 3A, 1459 kt in 2006 [EEA, 2008a]).

4.4.3. VOC reduction options and reduction potential

'Non-automotive' paint aerosols are paints packed in aerosol dispensers (spray cans). CEPE and FEA have commented on the 'historic' reasons of the development of aerosol-type paints, and their advantages, considered as relevant for prediction of the VOC-reduction potential within the product group. According to industry, the use of paint aerosols has the following advantages:

- they are ready to use and convenient products;
- they allow easy application of the product on complex surface profiles (e.g. bicycles, radiators) – also for recoating and touch-up (small repairs);
- they permit the application of special effect finishes on small items;
- they eliminate the use of solvents for cleaning of application equipment;
- the spray cans are hermetically sealed, providing a long shelf-life;
- they are an easy solution for spraying paints without need for a spray gun.

The use of liquefied gases (VOC) is essential for aerosol paint packaging/application systems. In order to ensure the spraying ability, the paints have to be diluted, which requires a certain additional amount of VOC solvent. Various solvent mixtures are used with acetone contributing the biggest volume. VOCs used as additional propellants in 'non-automotive' paint aerosols are the liquefied gases propane, butane and dimethyl ether.

Literature sources from the early '90s learnt that a number of 'emerging technologies' were described at that time [CREM, 1993]. These were compared to the traditional aerosol products, which were assumed to contain 80% VOC on average. The emerging technologies identified included:

- Novel spraying systems, such as 'pump & spray' and 'bag in can'. These were not yet regarded feasible at that time.
- Alternative propellants: compressed gases such as CO_2, N_2 and compressed air. These were (yet) not considered feasible, neither.
- Water-based aerosols (65% VOC content), using dimethyl ether as a propellant. Prototype products existed, but they were not state-of-art yet.
- High Solids aerosols (65% VOC content). Also for this alternative prototype products were known, but these were neither state-of-art yet at that time.

According to the inquiry of the project team made in the paint manufacturing industry, for a vast majority of 'non-automotive' paint aerosols it is still not (yet) technically feasible to reduce VOCs and retain product performance at the same time.

Paint technologists have developed a number of systems that can be used to reduce the VOC content of paints. Unfortunately these are - according to CEPE/FEA - not suitable for 'non-automotive' paint aerosols, for the following reasons [CEPE/FEA, 2008-1] [CEPE/FEA, 2008-2]:

- **High solid coatings**, i.e. 'concentrated products' with a higher content of solids, are applied in many industrial processes. However, they generally require adapted spraying devices to enable the more viscous products to be sprayed (e.g. pumps, hoses, heated spray guns). In order to be applied as an aerosol, the high solid coatings would have to be diluted again up to levels of the VOC-content of the conventional aerosol paints, thus negating the VOC reduction benefit.
- **Water-based coatings**: industry made attempts to place such water-based systems on the market, but technically they were unsatisfactory and not viable for the following reasons:

a) Incompatibility between resins and propellants.
Most waterborne coatings are not stable once a propellant is added because it will dissolve the dispersion or emulsion. As only one type of propellant can cope with water-based materials (dimethylether), the choice of raw material is limited. Thus, only a few waterborne coating systems are compatible in paint aerosols. However, these have not gained acceptance in the market [CEPE/FEA, 2008]

b) Poor atomisation of water-based paints when used in aerosol dispensers.
Main disadvantages of waterborne aerosol coatings that have been observed, compared to solvent-based products, were [CEPE/FEA, 2008]

- uneven flow
- lack of gloss
- 'spitting'
- foam formation.

c) Poor coating properties.
Disadvantages of water-based aerosol coatings tested so far had longer drying times, worse adhesion on some surfaces, poor resistance against water and weather (exterior applications), and less scratch resistance [CEPE/FEA, 2008-1]. However, these properties might be improved in future, similar to developments in general water-based coating technology.

d) Safety concerns when metallic ingredients are used with water; for example, if zinc is present, hydrogen could be formed.

- **Two-pack (reactive) coatings**: in 2008/2009, some two-pack spray-can technologies on the professional/industrial market. However, these paint aerosols cannot be used by consumers because of the need for personal protection equipment. Additionally, pot life (product shelf life after first use) is only of several days – as compared to years for conventional products.

Discussions on these issues during a meeting with CEPE and FEA (05/09/'08) learnt that the possibilities have not changed since the early 1990's. Current technologies for high solids in decorative paints using lower molecular weight binders and performing well for brush and roller application seem to be not (yet) feasible for aerosol spray application with propellants.

If sticking to the 'spray-can type' aerosol product, the VOC reduction potential is limited: The development and implementation of the 'emerging technologies' described in the 1990's would result in a VOC reduction of 11 % for the water-based aerosols and 14 % of the high solids aerosols, if calculated as g/l VOC [CREM, 1993]. Calculating with a 10 % reduction potential for all non-automotive product groups of paint aerosols (not considering actual feasibility), the resulting theoretical VOC reduction potential for EU-27 would be about **1.9 kt**.

Another, far reaching option is a complete phase-out of the solvent using propellent spray-cans, aiming at a future substitution by compressed-air can technique or by brush and roller application. However, brush and roller techniques will not be applicable without compromising performance in the specific applications aerosol-type paints are used in. If substitution by compressed air technique could achieve acceptable quality, it has to be considered that high-solid solvent-based paints would still contain about 50 % VOC, compared to a total VOC content of about 70 - 80 % at present. Based on above mentioned data of FEA [D'Haese, 2008a], this would result in a VOC reduction of 1/3 of the current amount, hence in EU-27 about **7.0 kt** in 2010 and **8.5 kt** in 2020.

4.4.4. Conclusion regarding the inclusion of 'non-automotive' paint aerosols into the scope of Directive 2004/42/EC

Total VOC emissions of "non-automotive" paint aerosols were estimated by CEPE/FEA with about **19.7 kt** in 2007 in EU-27, and projected to be **21.1 kt** in 2010 and **25.5 kt** in 2020 [D'Haese, 2008a]. Considering on these estimates, the relative contribution of "non-automotive" paint aerosols can be regarded as relatively small, contributing with about 0.7% to total VOC emissions and about 1.7 % to VOC emissions from the paint sector.

The inclusion of "non-automotive" aerosol paints into the scope of Directive 2004/42/EC would require clear definitions of product groups under the same VOC limits for a large variety of more than 40 product types, used for different types of application. Although the observed range in VOC content expressed as gramme VOC per litre of product (roughly a factor 2) mainly seems to reflect variations *between* different product types, and not *within* one product type, but nevertheless, the large variety of products may hinder the development of a short list of unambiguous groups, being clear and easy to monitor.

If emerging technologies can be realised, an overall reduction potential of 10 % may be achieved, resulting in a VOC reduction of about **1.9 kt** in EU-27.

As long as no alternatives exist with similar product performance as achieved with current aerosol can systems, the substitution of propellent using aerosol cans is questionable considering the limited VOC reduction potential of about **7.0 kt** in 2010 and **8.5 kt** in 2020. Therefore no impact assessment has been done on this option. It is recommended to assess in future whether non-VOC aerosol cans have been developed with satisfying product performance, allowing a higher VOC reduction potential than at present.

5. Improvement of scope definitions in Directive 2004/42/EC (Option 1)

5.1. Problems due to different scope interpretations and proposals for more clearity

5.1.1. Description of the problem

Directive 2004/42/EC aims at a harmonisation of the European markets. Member States have indicated that harmonised implementation of the directive is hindered by different interpretation of the scope for paints and varnishes.

Member States and stakeholders have reported difficulties to guarantee a harmonized implementation regarding the scope for paints and varnishes due to different interpretations of the terms ‘buildings, their trims and fittings, and associated structures’. More information on the consultation of Member States and stakeholders can be found in annex 3.1 on page A-24).

The project team has assessed possibilities to avoid ambiguity about the scope.

5.1.2. Possible solutions

Member States suggest solving the problem

- or by clear definitions
- or by extension of the scope, deleting the restriction to paints and varnishes applied for ‘*buildings, their trim and fittings, and associated structures’.*

CEPE proposes to include protective coatings into the scope of Directive 2004/42/EC, aiming on the one hand at further VOC reduction and on the other hand at a harmonised interpretation of the scope of Directive 2004/42/EC.

CEPE reported inconsistencies between Member States "in interpretation of the term ‘building’ (as used in the scope of annex 1) and whether the PD applies at site, in shop or both etc". [CEPE, 2008]

With its proposal to include protective coatings, CEPE intends to provide a more even level playing field across the EU, in particular when coatings are used for metal structures like bridges. These are considered by few Member States as covered by the scope of the directive, but by most Member States not.

The project team suggests to either keep the current terms and provide clear interpretations of what is meant by the words "building", "trims" and "fittings" or to delete "trims" and "fittings" if no clear definition can be provided.

When considering a definition for inclusion in Directive 2004/42/EC, one has to bear in mind that in general European Commission legislation tries to be precise and clear. This means that enumerations ending with "etcetera" respectively with "or similar" are not precise enough and are intended to be avoided.

For the definition of a building in the context of Directive 2004/42/EC it is important to distinguish

- Whether or not a building has to have a roof (subway stations do not have a roof as such)
- Whether or not a building may be movable (movable homes are seldom in Europe, but contractors' sheds and containers are used for living)
- Whether or not a building is enclosed with walls or may just have a roof

The project team proposes to take up the following definition for "building", originating from the building sector:

ISO 6707-1:2004
Building and civil engineering - Vocabulary, Part 1 - General terms
3.3 Building
construction works (3.11) that has the provision of shelter for its occupants or contents as one of its main purposes and is usually enclosed and designed to stand permanently in one place.

Based on the New Oxford Dictionary, the following definitions could be used:

Trim: Additional decoration, typically along edges of something and in a contrasting colour or materia

Fitting: Items such as a cooker or shelves which are fixed in a building but which can be removed when the owner leaves

Fixtures: Articles attached to a house or land [building] and considered legally to be a part of it so that they normally remain in place when the owner moves

The term "trim" seems to be a rarely used and is regarded as superfluous.

The term "fitting" should be substituted by the easier term "fixture", but the explaination would only make sense if built-in kitchens and built-in wardrobes are regarded by all Member States as belonging to the building and therefore being under the scope of the Directive.

The consultants doubt whether agreement and harmonised implementation can be achieved on the question whether these temporarely fixed items are covered by the Directive or not. It is recommended to take up option 8, extending the scope of the directive to all wood coatings, including furniture, to avoid ambiguity regarding the coating of such furnitures.

6. New product grouping for vehicle refinishing (Options 2 and 3)

6.1. Description of the problem

In contrast to decorative coatings, the VOC content of vehicle refinishing products except category (a) has to be expressed *without* counting the water content (annex II-B). At present, this definition allows using:

- Two stage systems consisting of water-based **basecoats**
  (< 150 g/l 'ready-to-use' (determination with water content), equivalent to
  < 420 g/l after discounting the water-content),
  combined with a solvent-based **clearcoat**
  (< 420 g/l 'ready-to-use', not containing water); or
- Single stage **topcoat** systems - solvent-based - at 420 g/l.

This leads to the conclusion that a separate product group for basecoats with a maximum VOC content of 150 g/l could be defined, referring to 'ready-to-use'.

CEPE has stated that the market share of single stage topcoat system for passenger cars has been rapidly declining, generally substituted by systems using water-based basecoats and solvent-based clearcoats [CEPE, 2008c].

"*Special finishes (cat. e)* - This category currently incorporates a large variety of products. According to CEPE, it has appeared that this category is often misunderstood. CEPE has proposed a clarification of the definition, combined with:

- Further distinction in two subcategories with different VOC limits – partly stricter than the current limit.
- Shift of a few product types to categories c) and d) with lower VOC limits.
- Add plastic adhesion promoters, tyre paints and rim silver paints to cat. e).

6.2. Description of the options

6.2.1. Option 2: Assessment of defining an additional VOC limit value specific for water-based vehicle refinishing products in the category B (d) ‘topcoat’

Option 2 foresees a separation of the existing product category (d) ‘topcoats’ into two sub-categories with different VOC limit values. This means that the current VOC limit value of 420 g/l would no longer be valid for all sub-categories of topcoats but only for clear coats and single-layer topcoats. A new limit value for basecoat topcoats would be established by the option. Its VOC content would have to be measured without discounting the water content but referring to the entire coating system.

At present, Directive 2004/42/EC foresees that "any water content of the product ready for use should be discounted" (see footnote in table Annex II B) when determining the VOC content.

It is proposed to delete this footnote, bringing the VOC analysis of the vehicle refinishing sector in line with the one used for decorative coatings (analysed as ‘ready-to-use’ product without water content discounting). Having the same definition for determination of the VOC content of vehicle refinishing products as for decorative coatings would mean a simplification by using the same reference throughout the directive. It would mean that e.g. a water-based refinishing product with only 150 g/l VOC (as it is state-of-the-art for basecoats) would be classified with this low number. Under the current specification proceeding, by discounting the water content, the VOC content has to be referred to the paint system without water, ending up in a VOC content specification of about 420 g/l. This shows that the low VOC content of the ready-to-use water-based systems are not reflected under the current proceeding. Hence, customers are not able to realise the environmental advantage of a low VOC content when reading the current classification and comparing it to the one of a solvent-based system.

6.2.2. Option 3: Assessment of a shift of certain products from the current vehicle refinishing category (e) 'special finishes' to categories with stricter VOC limit values

Option 3 proposes to shift 8 product groups from category e) with the highest VOC limit (840 g/l) to existing categories with lower VOC limits.

Furthermore 3 additional product groups are proposed for inclusion into the scope of Directive 2004/42/EC as set out in Table 15. For these product groups an inclusion into the product group with the highest VOC limit of 840 g/l is proposed (equivalent to proximate 100w.-% VOC).

Table 15: Stricter limits proposed for the vehicle refinishing sector

Option No.*	Summary	Description
2	Defining additional VOC limit values specific for water-based vehicle refinishing products in the category B (d) 'topcoat'	It is proposed that the existing product category (d) 'topcoat' currently setting a limit value of 420 g/l for all kinds of topcoats will be separated into two sub-categories with different VOC limits. The sub-categories will be as follows: <u>Topcoat Categories VOC limit value (ready-to-use)</u> d-1 Basecoat 150g/l d-2 Clear coat 420g/l Single layer topcoats 420g/l
3	Shifting of certain products from the vehicle refinishing category (e) 'special finishes' to categories with stricter VOC limit values	The proposal is to (a) clarify the definition of 'special finishes (cat.e)', (b) move some products to categories c. and d. with lower VOC limits, (c) split category e. into two subcategories, one with lower VOC limits than the other and (d) add some products to category e. Proposed classifications are as follows: <u>Current category Subtype Proposed category/limit</u> Cat e.(840g/l) anti-chip coatings Cat c. (540 g/l) underbody sealers Cat e.(840g/l) topcoat: Cat d. (420 g/l) -metallic or pearl effect, single layer -high-performance solid colour clearcoats (e.g. anti-scratch and fluorinated clearcoat) Cat e.(840g/l) reflective base coats Cat e-2 (540 g/l) textured finishes matt finishes anti-slip coatings Not in scope plastic adhesion promoters Cat e. (840g/l) tyre paints rim silver paints Products not mentioned in the table remain unchanged (e.g. fade-out thinner needed for spot repair, which remain in class e.).

6.3. VOC reduction potential and reduction scenario

The complete calculation of the VOC reduction potential of options 2 and 3 can be found in annex 4 on page A-41.

6.3.1. VOC reduction potential of option 2

The estimation of the reduction potential of option 2 per country in EU-27+2 is based on data for the market of vehicle refinishing products provided by CEPE for the years 2003 and 2007 covering EU-15 plus Malta and Cyprus. This data shows a share of 31 % solvent-based basecoats in 2007.

Data provided was used to estimate data for EU-27 Member States plus Turkey and Croatia. This data set was extended to the EU-27 Member States, based on gross domestic products (GDP) and extrapolated to future years, assuming annually constant growth rates for each member state reflecting different growth rates across member states. On the average, a positive market development of water-based basecoat products can be observed while the market development for solvent-based products was observed to be negative for the EU-15 Member States.

Based on CEPE data for EU-15, for the extrapolation two-thirds of all base-coating products in the vehicle refinishing market for 2007 are assumed to be water-based products and one-third solvent-based products.

The reduction potential for each country of the EU-27+2 was estimated through comparison of the VOC emissions from a “business-as-usual” (BAU) scenario where no regulatory changes will intervene in the market development and a DECOPAINT-NEW scenario where the above mentioned changes within the topcoat category will be implemented.[22]

Table 16 shows extrapolations of option 2 for 2015 and 2020, resulting in a VOC reduction potential of 3.33 kt respectively 3.20 kt in EU-27 in the year 2020.

The reduction potential results from a decrease in VOC limit values for base-coats from currently 420 g/l for solvent-based products and 250 g/l for water-based products to a new limt value of 150 g/l and thus substitution of all solvent-based products by water-based products.

[22] For the estimations of the reduction potential an emission factor of 0.95 was applied. Thus, not all of the VOC content is emitted but 5% of the VOC are assumed to remain in the container and are not released into the air. This factor is based on an agreement of experts during the compilation of the German emission inventory.

Table 16: VOC reduction potential by introducing a new limit value for vehicle refinishing basecoats (Option 2)

Country	2015	2020
	kt	kt
Austria	0.05	0.04
Belgium and Luxemburg	0.14	0.13
Bulgaria	0.01	0.01
Czech Republic	0.03	0.03
Denmark	0.06	0.06
Estonia	0.00	0.00
Finland	0.02	0.01
France	0.24	0.18
Germany	0.52	0.46
Greece and Cyprus	0.16	0.17
Hungary	0.03	0.02
Ireland	0.12	0.18
Italy and Malta	0.62	0.61
Latvia	0.01	0.01
Lithuania	0.01	0.01
Netherlands	0.10	0.08
Poland	0.08	0.07
Portugal	0.10	0.09
Romania	0.03	0.03
Slovakia	0.01	0.01
Slovenia	0.01	0.01
Spain	0.44	0.44
Sweden	0.08	0.09
UK	0.47	0.46
EU-27	3.33	3.20
Croatia	0.01	0.01
Turkey	0.12	0.11

6.3.2. VOC reduction potential of option 3

The estimations for option 3 are based on the same data base as described above for option 2. Results for option 3 are presented in Table 17.

The results in the table are presented in tonnes because of the relatively small amounts of reduction potentials for this option.

Table 17: VOC reduction potential of new limit values for several vehicle refinishing product groups (Option 3)

Country	2015	2020
	kt	kt
Austria	0.001	0.000
Belgium and Luxemburg	0.030	0.042
Bulgaria	0.000	0.000
Czech Republic	0.001	0.000
Denmark	0.001	0.000
Estonia	0.000	0.000
Finland	0.000	0.000
France	0.010	0.004
Germany	0.056	0.049
Greece and Cyprus	0.007	0.011
Hungary	0.001	0.000
Ireland	0.011	0.034
Italy and Malta	0.006	0.002
Latvia	0.000	0.000
Lithuania	0.000	0.000
Netherlands	0.001	0.000
Poland	0.002	0.001
Portugal	0.006	0.006
Romania	0.001	0.000
Slovakia	0.000	0.000
Slovenia	0.000	0.000
Spain	0.059	0.070
Sweden	0.000	0.000
UK	0.024	0.018
EU-27	0.217	0.239
Croatia	0.000	0.000
Turkey	0.004	0.002

6.4. Summary of impact assessment including ozone reduction potential and cost-benefit analysis

A detailed description of the impact assessment, the ozone reduction potential and the cost-benefit analysis can be found in annex 4 (p. A-41) for both options.

6.4.1. Background information: Current market and impact of the two options

Market information relating to the products that would be impacted by these two options has been difficult to identify. Consultation with CEPE has not provided any information regarding the current market breakdown between compliant and non-compliant products. In the absence of this information, it is not possible to identify the number of manufacturers that might be affected.

However, CEPE has confirmed that a VOC content of less than 840 g/l is already state-of-the-art for the product groups currently falling under category (e) 'special finishes' and intended to be shifted to other categories and that it will therefore not be difficult to achieve lower levels in the proposed product groups.

6.4.2. Impacts on manufacturers

The option is not anticipated to have any significant effect on manufacturers of the relevant categories of vehicle refinishing coatings. As mentioned above, state-of-the-art products already exist, complying with the VOC limit values of the proposed new categorisation. It is not expected that manufacturers will incur significant investment costs as a result of requiring new equipment. Some reformulation and research and development expenditure might be required but, given sufficient lead-in time to enable manufacturers' to link this to regular reformulation cycles, CEPE would not be expected related costs to be significant.

Any labelling costs to manufacturers for new products coming under the scope of the Directive could be minimised if requirements were timed so as to coincide with those coming into force under the Regulation on Classification, Labelling and Packaging, requiring compliance in June 2015.

No impacts on the competitive position of EU manufacturers within the EU market are expected by the trade associations consulted during the study.

6.4.3. Impacts on professional users

A member association of CECRA, the European Council for Motor Trades and Repairs, confirms that the option would not necessitate the purchase of new equipment other than already required for operating competitively under current legislation. Additionally, the association confirmed that operating costs would be unlikely to increase, with any increase in the prices of some categories of products only representing a small part of the overall job cost. Firms going out of business as a result of failing to compete would inevitably do so even in absence of the option being implemented.

According to AIRC consultation response, Options 2&3 would not necessitate substantial investment by the vehicle repair sector. In some cases, minor adjustments of storage facilities may be needed but in most cases adjustment may be achieved without incurring additional investment.

The availability of already compliant products (confirmed by both CEPE and association affiliated with CECRA) means that there would be little or no impact on product performance or product price from the point of view of professional users.

6.4.4. Impacts on consumers

The only potential areas of impacts to consumers resulting from these options relate to product performance and price paid for vehicle refinishing work. Whilst there is some difference of opinion between those organisations consulted regarding the performance of the products with lower VOC content, there are a substantial number of these products already being used in the market to the satisfaction of both professional users and consumers.

This being the case, it is not expected that the options would involve any significant costs to consumers in terms of a decrease in overall product performance. Since compliant products are already in existence and widely used, it is also expected that there will be no significant increases in costs to consumers for vehicle refinishing work.

6.4.5. Impacts on Member State authorities

Some additional costs may be involved for Member State authorities for carrying out monitoring activities. The three additional products proposed to fall within the scope of the Directive are expected to have low market volume, but will need to be monitored above those products already subject to the provisions of the Directive. However, product groups will generally use the same distribution channels as used for products already under the scope. Mainly, the options' changes consist of reductions of existing limits by moving products from one category to another, i.e. Member States will still need to monitor the same products. Considering these facts, it is expected that the overall increase in monitoring and surveillance costs would be minimal.

6.4.6. Ground level ozone reduction and related benefits

The implementation of the options will result in a reduction of anthropogenic VOC emission of about 3.5 ktons by 2020 in EU-27 and about 1.0 kton in Croatia and Turkey. This may result in an overall negligible reduction (< 0.001 %) of the average ground level ozone concentration in EU-27+2 in 2020 compared to the situation without the implementation of the options.

The expected benefits on human health have been estimated for 2020 to be approximately € 700,000. Furthermore the ozone reduction may contribute to prevent part of the production losses due to crop damage. This has been quantified for 2020 with approximately €370,000 in total Europe (EMEP grid).

6.5. Summary table on impact assessment results

Table 18 sets out a scoring system for the envisaged major impacts likely to arise from implementation of the options 2 and 3, proposing new limit values for several categories of vehicle refinishing paints and introducing three product groups into the scope of the directive. The scores are based on the more detailed assessment of the options' impacts presented in Annex 4.

Table 18: Summary Impact Assessment

Stakeholder Impact	Manufacturers	Professional Users	Consumers	Member State Authorities
Economic				
Capital/investment costs	0	0 or -/?	n/a	n/a
Operating costs	0	0	n/a	-/?
Product and raw material prices	0	0	0	n/a
Imports/competitiveness	0	0	n/a	n/a
Competition	0	0 or -/?	n/a	n/a
Entry costs	-/? or 0	0	n/a	n/a
Innovation/research	-/? or 0	0	n/a	n/a
Product performance	n/a	0 or -/? depending on product used	?	n/a
Monitoring/Surveillance costs	-	n/a	n/a	+/-
Social				
Employment	0	0	n/a	n/a
Health				
Environmental				
Cross media	0			
Waste and recycling	0			
Fuel consumption vehicle emissions	0			
Use of renewable/non-renewable resources	-/? or 0 (depending on energy consumption)			
Key: 0 = no impact +/- = uncertain impact positive or negative -/? = likely slightly negative impact but unquantifiable due to lack of data + = Positive impact ++ = Strongly positive impact - = Negative impact -- = Strongly negative impact				

7. Amendment proposal: Stricter VOC limit values for interior paints (Options 4)

7.1. Description of the option

Option 4, is based on differentiating between interior and exterior applications of decorative paints, with VOC-limits for interior paints being set at more stringent levels than for exterior paints in categories d), e) and f). Table 19 shows current and proposed new limits.

Table 19: Existing and Proposed (green) VOC Limits for Interior and Exterior Paints

EXISTING VOC LIMITS (as per Directive 2004/42/EC)			PROPOSED VOC LIMITS (assumed from 2015 on)	
d) Interior/exterior trim and cladding paints for wood, metal or plastic substrate			dI) Interior trim and cladding paints for wood, metal or plastic substrates	
	Phase I (g/l) 1.1.2007	Phase II (g/l) 1.1.2010		Phase III (g/l) from 2015 on
WB	150	130	WB	130
SB	400	300	SB	130
			dII) Exterior trim and cladding paints for wood, metal or plastic substrates	
				Phase III (g/l) = Phase II
			WB	130
			SB	300
e) Interior/ exterior trim varnishes and woodstains, including opaque woodstains			eI) Interior trim varnishes and woodstains, including opaque woodstains	
	Phase I (g/l)1.1.2007	Phase II (g/l) 1.1.2010		Phase III (g/l) from 2015 on
WB	150	130	WB	130
SB	500	400	SB	130
			eII) Exterior trim varnishes and woodstains, including opaque woodstains	
				Phase III (g/l) = Phase II
			WB	130
			SB	400
f) Interior/ exterior minimal build woodstains			fI) Interior minimal build woodstains	
	Phase I (g/l)1.1.2007	Phase II (g/l) 1.1.2010		Phase III (g/l) from 2015 on
WB	150	130	WB	130
SB	700	700	SB	130
			fII) Exterior minimal build woodstains	
				Phase III (g/l) = Phase II
			WB	130
			SB	700

For the impact assessment it was assumed that the new limit values will come into force in 2015. The VOC emissions resulting from implementation of the option were compared with a "business as usual" scenario, reflecting the current limits of Directive 2004/42/EC and its defined limits for 2010 (Phase II).

Decorative coatings in Categories d), e) and f) would be affected by the proposal, with the suggested limit for solvent-based interior paints in these Categories being set at 130 g/l. This would mean a phase-out of solvent-based coatings for interior use in these product categories.

The option reflects a Swedish proposal (compare annex 1.1.2 on page A-4), documented already in the background study of 2000 when preparing Directive 2004/42/EC [Van Broekhuizen et al., 2000].

7.2. VOC reduction potential and reduction scenario

The first rough estimation of the first project phase came to the result that an annual VOC reduction of 27.8 kt may be achieved by implementing the option.

CEPE provided background data on quantities of paints and resulting VOC emissions, based on current VOC content in 2003 and 2006 respectively, and covering the former EU-15 Member States plus four additional countries.

Figures for other countries of EU-27+2 countries (including Croatia and Turkey) were estimated by the project team, using national GDP data for all countries in combination with the provided data of 19 EU countries.

For the approximation a differentiation of the amounts used for indoor and outdoor applications had to be accomplished. In consultation with CEPE, the shares were set as shown in the Table 20 for the concerned categories categories d), e) and f) (classified as numbers 3 to 5 in the CEPE data).

Table 20: Option 4 – Separation of interior and exterior applications of paints for categories d), e) and f)

Category		%-share
Interior/exterior trim and cladding paints for wood and metal (cat. d)	Interior	50%
	Exterior	50%
Interior/exterior trim varnishes and woodstains, including opaque woodstains (cat e)	Interior	30%
	Exterior	70%
Interior and exterior minimal build woodstains (cat. f)	Interior	10%
	Exterior	90%

Data from 2006 was extrapolated to show scenarios for the years 2010, 2015 and 2020. For this extrapolation, a constant annual growth rate for all years between 2006 and 2020 was assumed, and the compound annual growth rate (CAGR) for 2003 and 2006 data was used.

Table 21 shows the results of an implementation of option 4, showing the related VOC reduction potential in 2015 (year of assumed implementation of the option) and 2020 compared with the development of VOC emissions in a "business-as-usual" (BAU) scenario without additional regulatory interventions.[23]

The result of the estimation shows for EU-27 a VOC reduction potential of 26.1 kt in 2010 and 25.4 kt in 2020 from implementing separate VOC limit values for interior paints according to option 4.

Table 21: VOC reduction potentials in EU-27+2 by implementing separate VOC limits for interior paints (Option 4)

Country	2015	2020
	kt	kt
Austria	0.20	0.19
Belgium	0.50	0.49
Bulgaria	0.06	0.06
Cyprus	0.73	0.71
Czech Republic	0.27	0.26
Denmark	0.26	0.25
Estonia	0.03	0.03
Finland	0.21	0.20
France	1.66	1.60
Germany	2.95	2.85
Greece	0.66	0.63
Hungary	0.73	0.71
Ireland	0.41	0.39
Italy	3.44	3.32
Latvia	0.04	0.03
Lithuania	0.06	0.05
Luxemburg	0.00	0.00
Malta	0.01	0.01
Netherlands	1.16	1.14
Poland	1.93	1.85
Portugal	0.29	0.28
Romania	0.21	0.20
Slovakia	0.43	0.51
Slovenia	0.08	0.07
Spain	3.59	3.49
Sweden	1.09	1.07
UK	5.11	4.98
EU-27	26.09	25.38
Croatia	0.10	0.10
Turkey	0.94	0.92

23 For the estimations of the reduction potential an emission factor of 0.95 was applied. Thus, not all of the VOC content is emitted but 5% of the VOC are assumed to remain in the container and are not released into the air. This factor is based on an agreement of experts during the compilation of the German national VOC emission inventory.

7.3. Summary of impact assessment including ozone reduction potential and cost-benefit analysis

The detailed impact assessment is documented in annex 4 on page A-41.

7.3.1. Background Information: Current Market and Impact of Option

The performance of decorative paints in an external environment is required to be higher and more durable than when used inside a building due to their exposure to the elements, and consequently a high solvent content is generally necessary for wood and metal (not for mineral) substrates. The option proposes to set lower VOC limits for paints in certain categories intended for interior use whilst maintaining the Phase II 2010 limits currently included in the Directive for exterior paints.

Currently, there are approximately between 4,000 and 8,000 paint manufacturers who are supplying at least some products that would become non-compliant should the new limit proposed under this option come into force. Unfortunately, a breakdown of products in the three different categories by interior and exterior use has not been available and it is consequently difficult to quantify the scale of any effects across the industry.

Imports of decorative paints into the EU are relatively small (as notified by CEPE) and it is unlikely that there will be any significant impact from the option in this respect.

7.3.2. Impacts on Manufacturers

The industry trade association, CEPE, indicated during consultation that significant investment would be required as a result of the option, due to the fact that it creates additional product categories with stricter VOC limits and that this increases product range and market complexity. Manufacturers would be required to provide additional storage space and working capital to cover marketing activities etc.

Consultation provided very little information on the magnitude of these costs. One company (with a production value of approximately €5 million per annum) estimated the total cost of moving to compliant products would be around €1.25 million. However, without a breakdown of this figure it is difficult for the study to comment on this.

The segmentation of the market described above will increase start-up costs for new companies by approximately 2.5 to 5% (according to CEPE). However, whilst market segmentation and the need to supply an increasing product range may cause existing companies to incur higher costs and may mean that new companies face higher start-up costs, such product differentiation may provide opportunities for smaller companies looking to supply niche parts of the market.

In addition, implementation of this measure may require specific labelling requirements for paints for interior and exterior use. Whilst such labelling would represent an additional requirement, if it is coordinated with the introduction of the Classification Labelling and Packaging Regulation (Regulation 1272/2008), requiring new labelling by 2015, the option would effect moderate labelling costs on manufacturers.

Finally, CEPE has indicated that there could be a significant decrease in demand for particular resins as a result of the measure. Solvent-based alkyd resins are used widely in the production of decorative paints and CEPE estimates that demand could fall for these by as much as over 50%. However, there would be a corresponding increase in demand for water-based resins due to the increasing demand for water-based decorative paints for use in interior applications.

7.3.3. Impacts on Professional Users

CEPE has estimated that professional users will end up having to pay between 5% and 10% extra for products under this option. The study team has been unable to verify these figures independently and it is unclear at this stage how these estimates were derived.

The phasing out of solvent-based paints in interior applications may also require that professional users have to increase drying times when using water-born paints. However, it is generally recognised that this largely depends on the actual situation on-site. Water based paints in fact dry more quickly than solvent-based paints at low humidity and high (> 20°C) temperatures. On the other hand, at low temperatures and high humidity, drying times of water-based paints may become problematic.

7.3.4. Impacts on Consumers

Similar to the situation regarding the price of professional products, CEPE has suggested a potential 5% to 10% increase in the price of consumer products as being a likely consequence of the option; again the study team has been unable to develop a break down to verify these figures.

7.3.5. Impacts on Member State Authorities

Member States such as Ireland and Spain have indicated that they do not feel that there would be a substantial, if any, increase in surveillance activities and costs. This may be due to the fact that the products which fall under this option are already covered by the Directive and will therefore be subject to monitoring and surveillance activities anyway; any new information requirements or checking that may need to be carried out to cater for the division between interior and exterior paints could be done within the context of these normal surveillance activities.

Monitoring the restriction on the use of certain paints for interior applications is likely to be more difficult though, as the higher VOC containing paints would still be available on the market.

7.3.6. Environmental Impact: Ground level ozone reduction and benefits of the ozone reduction

The implementation of the option will result in a reduction of anthropogenic VOC emission of more then 25 ktons by 2020 in EU-27 plus Croatia and Turkey as it has been estimated in this report (details are represented in annex 4.5 on page A-52). This may result in a marginal reduction of 0.009% of the average ground level ozone concentration in EU-27+2 in 2020.

The expected benefits on human health have been estimated for 2020 to be approximately €5.0 million. Furthermore the ozone reduction may contribute to prevent part of the production losses due to crop damage. This has been quantified for 2020 with approximately €2.7 million.

7.3.7. Other Environmental Impacts

Cross media effects may occur through waste disposal, as many people wash brushes used for water-based paints with water which then goes into the sewage system. Further segmentation of the market and increasing product ranges may also result in increased vehicle movements for transporting raw materials and finished products.

Small amounts of extra waste may be generated when people use different products for interior and exterior work. Simply using more different tins of paint can lead to more small quantities left at the bottom. In addition, use of metal tins (as currently used for solvent-based products) means that packaging is recyclable, whereas a lot of water-based products are sold in plastic containers; many of these are not recyclable.

7.4. Summary table on impact assessment results

The following table sets out a scoring system for the envisaged major impacts likely to arise from implementation of this option. The scores are based on the more detailed assessment of the options' impacts presented in annex 4 on page A-41.

Table 22: Summary Impact Assessment

Stakeholder Impact	Manu-facturers	Profes-sional Users	Consumers	Member State Au-thorities
Economic				
Capital/investment costs	--/?	0	0	n/a
Operating costs	Unknown	-	n/a	-/?
Product and raw material prices	--	-	-	n/a
Imports/competitiveness	0	0	n/a	n/a
Competition	-/?	0	n/a	n/a
Entry costs	-/?	0	n/a	n/a
Labelling costs	0	n/a	n/a	n/a
Innovation/research	-/?	n/a	n/a	n/a
Supply chain impacts	+/-	n/a	n/a	n/a
Product performance	n/a	-/?	0	n/a
Monitoring/Surveillance costs	-	n/a	n/a	-/?
Social				
Employment	-/?	0	n/a	n/a
Health		+	+	
Environmental				
Cross media	+/-			
Waste and recycling	-/?			
Fuel consumption vehicle emissions	-/?			
Use of renewable/non-renewable resources	-/?			

Key:
0 = no impact
+/- = uncertain impact positive or negative
-/? = likely slightly negative impact but unquantifiable due to lack of data
+ = Positive impact
++ = Strongly positive impact
- = Negative impact
-- = Strongly negative impact

8. Amendment proposal: Adaptation of analytical methods (Options 5, 6 and 7)

8.1. Description of problems

Problems with the analytical methods currently prescribed by Directive 2004/42/EC have been reported by Member States or stakeholders. Details can be found in annex 3.2 on page A-27.

Reported problems relate to:

- Lack of available accredited laboratories to carry out the analyses in some member states;
- Reference to ISO-standard 11890-2 of 2002 for the analysis of the VOC content only, thus missing the improved, updated version of 2007;
- High costs involved with the methods;
- Absence of a reference to the simpler and cheaper method ISO 11890-1;
- Perceived non-suitability of method ASTMD 2369 in general;
- Non-suitability of ASTDM 2369 for polyester putties in specific;
- Unclear method description for determining film thickness of woodstains.

8.2. Possible solutions

Monitoring programmes had not been fully enforced up to the period of the inquiry; therefore the study team envisages that the lack of accredited laboratories will disappear with progressing monitoring activities, creating increased demand for application of the test methods.

Regarding the problem of elevated analysis costs, it has been noticed that the costly method ISO 11890-2 may be partially substituted by the less costly method ISO 11890-1 (see option 6 below).

The perceived lack of suitability of ASTDM 2369 in general appeared not to be justified (annex 3.2, page A-27). The lack of suitability of the method for polyester putties appeared to be justified. However, an assessment at Member States, CEPE and analysis laboratories revealed that no solution is known.

Options 5, 6 and 7 have been proposed for further assessment for solution of the other problems mentioned, regarding reference to an outdated standard, suitability of a less costly analysis method and regarding lack of clear description of the film thickness measurement method for woodstains.

8.2.1. Option 5: Updating in annex III the VOC content test method ISO 11890-2:2002 by ISO 11890-2:2007

CEPE has proposed the introduction of a new wording, referring to the latest version of the standard. As unexpected changes may occur, such a general reference is generally not usual in European legislation and not recommended.

Nevertheless, it may be advantageous to use the updated 2007 version of the standard test method ISO 11890-2.

The project team has assessed the differences between ISO 11890-2:2002 and ISO 11890-2:2007 to evaluate benefits of an inclusion of the updated standard version. The outcome of consulting laboratories was that:

- the two methods have minimal differences only,
- the costs will not or only marginally increase when introducing the updated version of 2007;
- no problems are expected from using the updated 2007 version;
- a slight improvement of the quality of the analyses is expected.

8.2.2. Option 6: Inclusion in annex III of additional test method ISO 11890-1:2007 for VOC content determination

It was expected that allowing application of ISO 11890-1 (‘difference method’) in addition to ISO 11890-2 (‘Gas-chromatographic method’) may improve determination of the complete range of products with solvent contents below 15 % as well as above 15 %. Under the current provisions of Directive 2004/42/EC, ISO 11890-2 is foreseen as only analysis method for non-reactive products. As ISO 11890-2 recommends using ISO 11890-1 for products with a solvent content below 15 %, some authorities have used ISO 11890-1 for VOC analysis accordingly, presuming that this would be "indirectly" allowed by Directive 2004/42/EC.

The project team has assessed the inclusion of ISO 11890-1:2007 as an additional method for VOC content determination, recommended for products not containing reactive diluents and providing of a VOC content of > 15 %.

The project team has also undertaken an assessment of the analysis costs of ISO 11890-1 in comparison with costs of ISO 11890-2.

Based on the assessment (annex 3.2, page A-27), the study team has arrived at the following conclusions:

- The method ISO 11890-2 alone, currently mentioned in the directive, is capable to analyse the full spectrum of paints (without reactive solvents), having a VOC content either below or above 15 %;
- However, the alternative method ISO 11890-1 is considerably cheaper; the relative costs of ISO 11890-1 and ISO 11890-2 are 1:4 to 1:4.5.
- In the text of method ISO 11890-2 it is advised to use the simpler and cheaper method ISO 1890-1 if the VOC content is above 15 %.
- Introducing the possibility to use ISO 11890-1 will allow determination by this cheaper method and will delete ambiguity about the "indirect" allowance of the directive for using also ISO 11890-1 if less than 15 % VOC is contained in a product.

For the conclusions mentioned above, the study team recommends to take up ISO 11890-1 as analysis method for products with < 15 % VOC content.

8.2.3. Option 7: Inclusion of an additional description of the method for measuring film thickness of wood stains

CEPE proposed a new annex IV with an additional description of the method for measuring the film thickness of wood stains to obtain more accurate results:

> “The film thickness is always to be measured on the wood substrate. Only the film above the wood surface is included. The method to be used is ISO 2808 method 5A that describes:
>
> - Measurement of dry film thickness by microscopic method
> - Recommended for film substrates of varying profiles
>
> The replica shall be produced according to description in EN 927-3 with 5 measurements on 3 chips and the mean value in microns is recorded. The film thickness is measured for the total coating system.” [CEPE, 2008a]

The project team has assessed the impact of this wording, by consulting laboratories and by asking for comments of Member States and stakeholders.

The outcome of the assessment is that no problems and no cost increases are expected from the propsed additional explanations.

8.3. Conclusions for adaptation of analysis methods for VOC content and woodstain film thickness determination

The study team proposes to amend Directive 2004/42/EC by

- Update in annex III the VOC content test method ISO 11890-2:2002 with ISO 11890-2:2007.
- Include in annex III the additional test method ISO 11890-1:2007 for VOC content determination.
- Insert a new annex IV to provide an additional description of the method for measuring film thickness of wood stains, inserting a reference to this description in annex I number 1.1f accordingly.

The following wording is proposed for the new annex IV:

For determination of film thickness of woodstains, ISO 2808 method 5A shall be used, recommended for film substrates of varying profiles, foreseeing micro-scopic method for measurement of dry film thickness.

Film thickness shall be measured on top of the wooden substrate, taking into account only the film above the wooden surface.

The replica shall be produced with 5 measurements on 3 chips according to description in EN 927-3. The mean value in microns shall used for determination of the film thickness resulting from the coating system. Declaration of film thickness shall refer to the measurement results of the entire coating system.

9. Potential scope extension to other VOC emitting product groups

9.1. VOC restrictions to products in the USA

9.1.1. Introduction

In the USA, a few states have adopted regulations on the VOC content of certain consumer products. Probably the most far reaching and detailed regulations exist in California.

The consultants have concisely evaluated the scope and content of these regulations. The regulations appear to be very detailed, and distinguish many product types and VOC limits. However, a number of crucial differences in the definitions used hinder a direct transposition to European regulations. The most relevant reason is the difference regarding the VOC definition.

9.1.2. Californian VOC regulations for consumer products

The Air Resources Board of the California Environmental Protection Agency (CARB) adopted the first regulation on VOC's in consumer products as early as in 1991. This regulation established the first VOC limits for aerosol and non-aerosol antiperspirants and deodorants [CARB, 2007].

Since that date, at least 18 additional regulations and amendments were adopted; the latest one in May 2008. By that date, a total of 150 VOC-limits had been adopted for 115 consumer product categories. [CARB, 2008]

Product categories for which VOC limits have been adopted include for example many types of adhesives, cosmetic products and cleaning agents, as well as various other categories such as automotive and leather, fabric and furniture care products, and insecticides. In total, the regulations comprise more than 200 pages of text, and are very detailed in nature, referring to many product categories and exemptions. Table 23 presents examples of current VOC limits.

Table 23: Examples of current VOC limits for consumer products in California

Product category	VOC-limit (% w/w)
Hair sprays (aerosols)	55%
Antipserspirant aerosols	50%
Deodorant aerosols	10%
Flea & tick insecticide aerosols	25%
Air fresheners, single-phase aerosols	30%

[CARB, 2008]

The limits shown in Table 23 seem to be very ambitious. However, due to various reasons (the VOC definitions being the most relevant) it is difficult to compare the limits to what is considered feasible in the European context, using the VOC definition of Directive 2004/42/EC ("Volatile organic compound (VOC)' means any organic compound having an initial boiling point less than or equal to 250°C measured at a standard pressure of 101.3 kPa").

9.1.3. Implications of the varying VOC definitions used

In the Californian regulations (as well as in the VOC regulations in other states of the USA), a basic definition of VOC is used in connection with several exemptions. The basic definition, describing VOC as being compounds with at least one atom of carbon (excluding non-organic compounds such as carbon monoxide and metallic carbides) is accompanied by the following exemptions [CARB, 2007]:

- Methane, methylene chloride, 1,1,1-trichloroethane, a number of chlorofluorocarbons (CFC's), hydro chlorofluorocarbons (HCFC's), hydrofluorocarbons (HFC's) and perfluorocarbons, as well as organic siloxanes;
- A few substances that have been exempted by US EPA because of their low reactivity: acetone, ethane, methyl acetate and parachlorobenzotrifluoride.

In addition, the so-called LVP-VOC have been exempted, which are:

- Compounds with a boiling point above 216°C;
- Compounds with a vapour pressure below 0,1 mm Hg.
- If no boiling point or vapour pressure is known: compounds with more than 12 C-atoms.

Furthermore, specifically for aerosol coating products, an additional reactivity criterion has been introduced, restricting the scope of the VOC-limits to compounds that have an ozone creation potential that is higher than certain specified levels.

On the other hand, several CFC's and HCFC's have been specifically prohibited in aerosol consumer products such as antiperspirants and deodorants. However, altogether the following differences with the European VOC definition can been seen, which explain the apparently ambitious VOC limits cited in Table 23:

- a lower cut-off boiling point (216°C instead of 250°C), allowing more solvents to be used as non-VOCs;
- exemptions for solvents such as acetone, 1,1,1-trichloroethane and volatile siloxanes;
- exemptions for HCFC propellants such as HCFC 125, HCFC 143a and HCFC 152a.
- further exemptions for aerosol coatings on the basis of a cut-off value for reactivity.

9.1.4. Conclusion with respect to the relevance of the Californian product regulations

In addition to the VOC definition, a few other issues hinder the assessment of the feasibility of the Californian regulations in the European context:

- Product definitions, which are not in all cases similar to those used by the European industry;
- Categories of products in the Californian regulations that are not known in the EU.

For these reasons, and in agreement with the European Commission, the consultants have decided not to evaluate the potential adoption of the California regulations in detail.

9.2. Information collection on products selected for possible scope extension

Directive 2004/42/EC aims at complementing measures taken at national level in order to ensure compliance with the ceiling for emissions of VOCs defined by the NEC Directive. (Directive 2004/42/EC, recital no. 3)

The project contract foresees evaluating the technical feasibility as well as costs and benefits of a possible extension of the scope of Directive 2004/42/EC to other product groups, proposing VOC limit values for these products.

The contract follows statement no 20 of the preface of Directive 2004/42/EC: '*A review should be made both of the scope for reducing the VOC content of products outside the scope of this Directive and the possibility of further reducing the VOC limit values already provided for.'*

The Commission has underlined on the kick-off meeting that from their point of view no specific product groups shall be focussed, except for 'aerosols for paints and varnishes' , following the invitation of article 9 of Directive 2004/42/EC to report to the Parliament on the potential for scope extension.

On the background of the existing Directive 1999/13/EC focussing on installations carrying out solvent use in their activities, the project team has selected only product groups for a possible extension of the scope of Directive 2004/42/EC that are used outside of installations and therefore resulting VOC emissions are difficult or impossible to capture, to reduce or to eliminate.

Typical product groups using solvents outside of installations are household products and architectural products. This is reflected in the current scope of Directive 2004/42/EC. Other typical products with relevant VOC emissions can be identified in VOC inventories like the one regularly updated by the European Environmental Agency for the purpose of monitoring the aims of the NEC Directive and the UNECE Convention on Long-Range Transboundary Air Pollution. [EEA, 2008a]

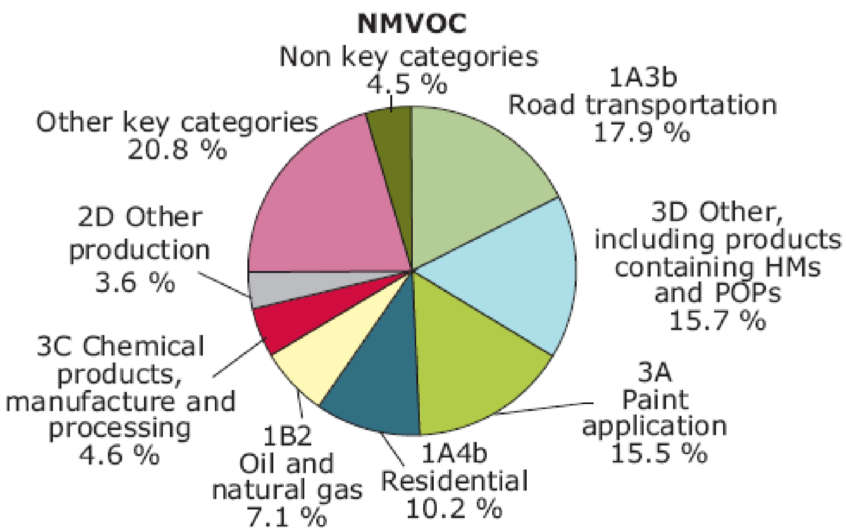
VOC emissions are classified with an internationally used reporting code. Solvent use is classified as category 3, comprising the following 4 subcategories:

- 3A Paint application
- 3B Degreasing and dry cleaning
- 3C Chemical products, manufacture and processing
- 3D Other – including products containing heavy metals and persistant organic pollutants (POPs)

Whereas categories 3B and 3C are typicall activities of installations, category 3A comprises open applications partly regulated by Directive 2004/42/EC, partly regulated by Directive 1999/13/EC, remaining several product groups without regulation (protective coatings, road coatings, bituminous products, waterproof sealings).

Category 3D comprises activities partly regulated by Directive 1999/13/EC (like printing, oil extraction, pharmaceuticals manufacturing, adhesive coating) and several many applications not regulated yet, like typical household applications (cosmetics, cleaners, adhesives, pharmaceuticals) as well as architectural applications (wood preservation).

Figure 10 shows the contribution of key categories to EU-27 emissions of non-methan VOC in 2006



[EEA, 2008a]

Figure 10: Contribution of key categories to EU-27 emissions of non-methan VOC in 2006

The figure shows that categories 3A and 3D cause major contributions to the total VOC emissions in 2006. In 2006, category 3 VOC emissions added up to 3.6 million tonnes in EU-27, accounting category 3A emissions for 1,458,700 t (40.5 %) and category 3D emissions for 1,473,000 t (40.9 %).

On this background the project team has analysed possibilities to reduce VOC emissions from products not regulated yet by Directive 2004/42/EC and not used in installations covered by Directive 1999/13/EC.

Indications for products groups with potential for VOC reduction have been made in studies like from AFC/BiPRO/DFIU on adhesives, cleaners and cosmetic products [EC, 2002] and in the study of IVAM/TME, assessing the VOC reduction potential of cosmetics and cleaners in Belgium and the Netherlands (Figure 11) [IVAM, 2005].

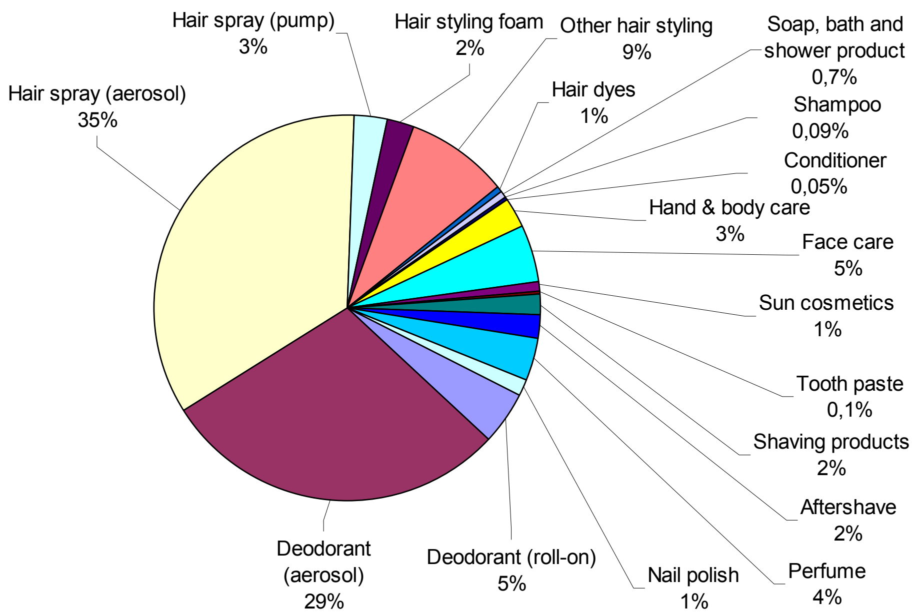
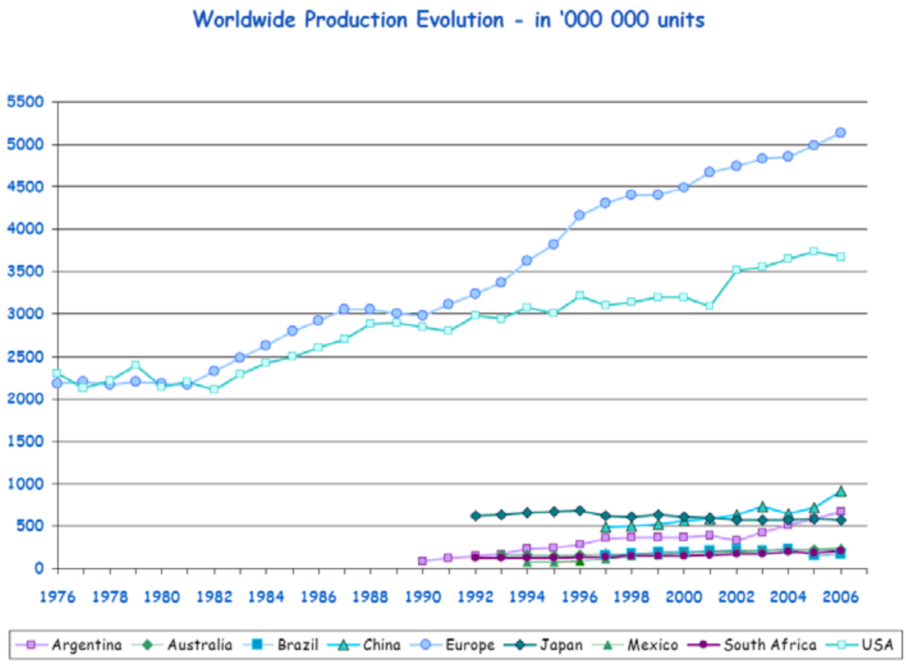


Figure 11: Share of VOC emission from cosmetic product groups in the Netherlands (2004)

Both studies have indicated that VOC emissions from aerosols contribute significantly to VOC emissions. Figure 12 shows the steep increase of aerosol can production by European companies, being the word's biggest producers.

Therefore the technical feasibility of substituting aerosols has been analysed e.g. in paints, in deodorants and hairsprays and in insecticide sprays.



[FEA, 2008]

Figure 12: Worldwide production of aerosol cans units from 1976 to 2006

9.3. Information collection on existing VOC limits for possible extension of the scope

All Member States in EU-27 have been inquired by the project team with a questionnaire on existence of national VOC-limits for non-regulated "*other* products (e.g. adhesives, cosmetics, cleaners, building-products)".

20 Member States answered the question. Table 24 gives an overview.

Table 24: Existing VOC limits for other products reported by Member States

Adhesives (ban or limits on certain VOCs)	Building products (ban or limits on certain VOCs)	Underwater coatings (ban or limits on certain VOCs)	Other limitation of VOC content (voluntary, partly limitation)	No additional VOC limit values
AT	AT	AT	CZ, DK, FI, NL, SE	BE, BG, CY, CZ, DK, EE, EL, ES, FI, IE, LT, LV, MT, NL, RO, SE, SI, SK, UK

Austria reports, that “Austrian solvent regulation (BGBl. 872/1995) bans the use of chlorinated compounds in building products, adhesives and underwater coatings, and limits the content of aromatic hydrocarbons in these products. There are no limits for the total VOC content” [AT Quest, 2008].

Czech Republic states, that it does “not have the legislation limits for other products” but that “some definitions of the Directive 2004/42/EC, however, are now defined more broadly” [CZ Quest, 2008].

Denmark reports that “for the purpose of workers protection, a system (MAL-code system) is set up based on the content of VOC and the hazard to humans.” [DK Quest, 2008].

In Finland, some companies use a voluntary classification system aiming at consumers' protection, used “for example for building products, for tiling products, adhesives and for mastics, fillers and screeds” [FI Quest, 2008].

In the Netherlands, VOC limits exist for all adhesives, but not for ‘placing on the market’ but when used by professionals (carpet layers and parquet layers): The VOC content needs to be < 5 g/l, meaning a prescription of VOC-free adhesives like water-based, reactive or hotmelt. [NL COT Report, 2008]

In Sweden, VOC limits are used on a voluntary basis by determination of requirements on content and use of organic solvents and VOC "for a number of products" [SE Quest, 2008] However, most of these limits require VOC emission measurement after product application, to improve indoor air quality. The same objective is aimed at by the so called ‘Emicode’ classification system established in Germany for indoor air quality when building produts like floor adhesives are used (http://www.emicode-produkte.de).

9.4. Member State proposals for extension of the scope

The Member States have been asked whether they have proposals for an extension of the scope of Directive 2004/42/EC. Table 25 shows the answers, received from 22 Member States (see details in annex 6.3, page A-75).

Two Member States propose inclusion of all type of paints, irrespective of their use. Four Member States proposed an extension of the scope to other decorative paints used in the context of ‘buildings’, recommending an extension for inclusion of "doors, radiators, bath-tubs, tiles, etc." Three Member States propose to extent the scope to all coating of wooden objects, regardless whether used for buildings, windows, furniture, etc.

Two Member States recommend inclusion of protective coatings; one Member State proposes marine coatings and another inclusion of daubs and putties.

One Member State advises deletion of the exception for vintage vehicles by Article 3(3) because low VOC alternatives would exist with a same final effect.

Table 25: Proposals of Member States for an extension of the scope of Directive 2004/42/EC

Product type	Member State
All products placed on the marked	CY, MT
Other deco products in housing situations for metal, wood (furniture) etc	BE, BG, CZ, EL
Vintage (historic) vehicles	BE
Vehicle trailer	SE
Marine coatings	EL
Heavy duty anticorrosive/ Protective coatings	AT, BE
Putties and daubs	LT
Road marking materials	AT
Aerosols	AT, BE, LT
Cosmetics	AT, BE, NL
Cleaners and household products	AT, BE, NL
Metal/hard surface cleaning products/degreaser	SE
Car and boat care products	SE
Certain application areas using printing inks	SE
Adhesives	AT
No proposal	EE, ES, FI, HU, IE, PL, RO, SI, SK, UK

Another Member State highlights that “the rules for vehicle trailers must be revised as well", underlining that “it has to be clear that refinishing of trailers is also within the scope of the Decopaint Directive.” It is argued that the definition of “refinishing of vehicles” and “coating of trailers” in Directive 1999/13/EC can lead to the interpretation that *refinishing* of trailers is covered by Directive 1999/13/EC (which would be the case for *original* coating of trailers, defined under the scope of Directive 1999/13/EC with the heading "vehicle refinishing").

Directive 2004/42/EC defines its scope for vehicle refinishing products by explaining that "they are used for coating of road vehicles as defined by Directive 70/156/EEC" (not covering trailers). Therefore it would not be clear, whether refinishing of trailers is in the scope of Directive 2004/42/EC. [SE Pers, 2008]

Three Member States propose inclusion of aerosols. Three Member States propose the inclusion of cosmetics, cleaners and other household products.

One Member State supports inclusion of adhesives and road marking materials. One Member State proposes scope extension to metal and other hard surface cleaning products and degreasers, to car and boat care products and to “certain application areas using printing inks”.

10. Potential scope extension covering motor cycle coatings (Option 10)

10.1. Description of the option

Option 10: Motorcycle coatings are not explicitely included in the scope of Directive 2004/42/EC because the scope of vehicle refinishing products refers to Directive 70/156/EEC.

It was assumed that for motorcycle coatings similar products are used as for vehicle coating, which would mean that an inclusion will lead to more clarity of the scope without bringing about any VOC reduction.

Consultations were done with the vehicle refinishing products manufacturers (CEPE sector group and individual producers) as well as with user organisations representing repair shops (CECRA, AISE). It was neither possible to obtain data of the total amount of specific motorcycle refinish used in Europe nor of the related VOC emissions.

10.2. Summary of the assessment

CECRA (European Council for Motor Trades and Repairs) supportes the view that motorcycling products already exist complying with the VOC limits of Directive 2004/42/EC. [CECRA, 2009]

AIRC (Association Internationale des Réparateurs en Carrosserie) stressed that not the same products are being used for car body repair and for motorcycle repair. For motorcycle repair more ink-like products would be used, also due to the type of material coated. Compared with vehicles, more parts of motorcycles are made of plastics and glass/polyester fibers. In particular fibers are difficult to refinish. For this reason, many parts like fenders and bodies are produced with pre-colored plastic/fibre material, where colors are mixed within the original parts. Additional refinishing is done for decorative purpose, often using adhesives and/or ink-like products. [AIRC, 2009]

AIRC stressed that despite the large number of motorcycle repair shops, most of them only replace parts by pre-colored spare parts. Only a very small number of dedicated motorcycle refinishing shops exists (e.g. only two association members in The Netherlands). Therefore, the impact of the scope extension to motorcycles is supposed to be very small. [AIRC, 2009]

CEPE vehicle refinishing sector group discussed the proposal of including motorcycles into the scope. CEPE argues that very bright and very-much-sparkling effects can only be achieved by the use of certain inks (dye solutions) which are not stable in water and have to be solvent-based systems. Due to the low concentration of the dyes, the VOC content of such components would come close to that of pure solvent.

Therefore, CEPE sector group for vehicle refinishing supports the proposal to extend the scope to motorcycles under the condition that certain colored top coats / basecoats containing colorants (unstable in water) shall be shifted from category d ("top coats", maximum 420 g/l VOC) to category e ("special coatings", maximum 840 g/l VOC equivalent to ~100w.-% VOC).

10.3. Conclusion of the assessment

Based on the assessment above it is proposed to extend the scope of Directive to motorcycle coatings to avoid ambiguity and achieving a scope that is covering the entire product range of refinishing products. This can also help to avoid misuse of products being declared as specific motorcycle coatings but used (and sometimes heard to be recommended) for vehicle refinishing.

This can be achieved by extending the reference for vehicle refinishing coatings in annex I of Directive 2004/42/EC under number 2. (The directive defining vehicles has been amended, therefore it is proposed to make reference to the amended 2007 version of that directive; see option 1 in chapter 5 on page 95):

"For the purposes of this Directive, 'vehicle refinishing products' means products listed in the subcategories below. They are used for the coating <u>of motorcycles and</u> *for the coating of road vehicles,* <u>the latter being</u> *defined in Directive* <u>2007/46/EC</u>*, or part of them, carried out as part of vehicle* <u>or motorcycle</u> *repair, conservation or decoration outside of manufacturing installations."*

As no technical alternatives are known, it is proposed to explicitly list "colored topcoats for motorcycles based on dye solutions" in category e) ("special coatings", 840 g/l limit) and to include all other specific products for motorcycles in the related existing category, e.g. transparent topcoats under category d) ("topcoats", 420 g/l limit).

11. Potential scope extension covering all coatings for wooden objects (Option 8)

11.1. Description of the option

Option 8: On the background of difficulties due to different interpretations of the terms ‘buildings’, ‘trims’, ‘fittings’ and ‘associated structures’ the project team will undertake an impact assessment of an extension of the scope to paints and varnishes that are not applied to ‘buildings’, ‘trims’, ‘fittings’ and ‘associated structures’. An extension of the scope covering all wood coating activities will be assessed.

The assessment will focus on the quantification of the VOC reduction potential, on potential problems of overlap with Directive 1999/13/EC. It will also focus on potential technical difficulties when applying paints and varnishes with VOC content according to the limits of Directive 2004/42/EC to objects like furniture, music instruments, etc to evaluate whether a general approach is feasible or whether excemptions for specific product groups have to be made.

First evaluations have indicated that application of water-based coatings is regarded as technically and economically feasible for all timber companies.

11.2. VOC reduction potential and reduction scenario

Background data for the estimation of the reduction potential of the initially presented proposal of new VOC limit products of the furniture and musical instrument sector was provided by CEPE as base for the development of the Thematic Strategy in the context of the 'CAFE' process (Clean Air for Europe). The data includes information on the total consumption of products and the share of different product types of this total for 18 countries of the EU-27 Member States. Furthermore, current VOC limit values have been provided which allow for an estimation of the total VOC emission for these countries. The estimations have are given for 2005, 2010, 2015 and 2020.

The extrapolation of data from the EU-27 aggregate level to the total figure for the EU-27 Member States plus Croatia and Turkey was accomplished by the application of GDP data for 2005. Furthermore, the total figure of consumption was distributed among the 29 countires using national GDP shares. Additionally, the shares of the different product types within the total consumption were used to estimate an average market share of each product type.

In discussions with CEPE, it was mentioned that the data provided by IIASA included installations that were already covered by the Solvent Emissions Directive (SED) and national legislations. To estimate the share of activities already covered by these regulations and to find out the amount of activities to be analysed in this option, the data IIASA provided for the estimations were compared to data from the German Emissions Inventory. For the further estimation of the reduction potential of option 8, assumptions on the percentage of products already covered by these regulations had to be made by the project team. These assumptions are summarised in Annex 7.

The two scenarios of an implementation of new VOC limit values for 2011 and 2014 have been estimated for the years 2015 and 2020. For 2010 only a business as usual scenario has been created. The resulting reduction potentials result from a comparison of the total VOC emissions of the DECOPAINT-NEW scenario and the BAU scenario.

The BAU scenarios for 2010, 2015 and 2020 have been estimated based on the data provided by CEPE and the additional estimations for those countries where no data was available. These estimations are described above. For the BAU scenario no regulatory intervention with respect to the VOC limit values has been assumed.

Two different DECOPAINT-NEW scenarios were analysed with respect to furniture and musical instrument sector. For 2015, a scenario a) was calculated where the new VOC limit values are implemented in 2011 and a reduction potential for this proposal was estimated. Additionally, in scenario b), the new VOC limit values for 2014 were assumed to be implemented and the results were calculated. For both scenarios it has been assumed that the disappearance of solvent-based products will not lead to a decrease in consumption but is replaced by an increasing demand for water-based products.

For 2020, it has been assumed that the first phase of the new limit values from 2011 has already been implemented and thus, only scenario b) of new limit valued from 2014 onwards has been analysed. As a result, two different reduction potentials for 2015 and one value for 2020 have been estimated.

Table 26 presents the resulting reduction potentials for the EU-27 Member States plus Croatia and Turkey. A total reduction potential for the EU-27 Member States of about 26 kt for scenario a) in 2015 has been estimated. For scenario b) the total reduction potential for the EU-27 countries declines from about 40 kt in 2015 to 32 kt in 2020 due to the decreasing development of the overall market for wood coating products.[24]

[24] For the estimations of the reduction potential an emission factor of 0.95 was applied. Thus, not all of the VOC content is emitted but 5% of the VOC are assumed to remain in the container and are not released into the air. This factor is based on an agreement of experts during the compilation of the German emission inventory.

Table 26: VOC reduction potentials in EU-27+2 from scope extension to all wooden objects (Option 8)

Country	2015		2020
	scenario a) kt	scenario b) kt	scenario b) kt
Austria	0.47	0.72	0.51
Belgium	0.35	0.52	0.19
Bulgaria	0.06	0.09	0.07
Cyprus	0.08	0.12	0.12
Czech Rebublic	0.25	0.39	0.33
Denmark	0.37	0.56	0.50
Estonia	0.09	0.13	0.12
Finland	0.40	0.62	0.52
France	4.38	6.78	5.70
Germany	3.02	4.46	2.19
Greece	2.42	3.81	3.84
Hungary	0.46	0.71	0.65
Ireland	0.41	0.64	0.54
Italy	4.81	7.56	5.43
Latvia	0.10	0.15	0.14
Lithuania	0.17	0.24	0.22
Luxembourg	0.08	0.12	0.10
Malta	0.01	0.02	0.02
Netherlands	0.39	0.58	0.52
Poland	0.52	0.77	0.72
Portugal	0.55	0.88	0.81
Romania	0.20	0.31	0.26
Slovakia	0.10	0.15	0.13
Slovenia	0.25	0.39	0.34
Spain	3.84	6.07	5.29
Sweden	0.75	1.16	0.97
UK	1.06	1.77	1.48
EU-27	25.60	39.71	31.67
Croatia	0.09	0.14	0.12
Turkey	0.98	1.52	1.28

11.3. Summary of impact assessment including ozone reduction potential and cost-benefit analysis

11.3.1. Background Information: Current Market and Impact of Option

Currently the situation regarding regulation of wood coatings appears to differ from member state to member state, with some applying VOC restrictions on wood coatings used by installations which fall below the 15 kt threshold applicable under Directive 1999/13/EC, whereas others have not. For example, in the Netherlands, the timber industry has had to apply wood coatings with a maximum VOC limit of 150g per litre since 2004.

This option proposes to extend the scope of the Directive to cover all wood coating activities that are presently not covered by Directive 2004/42/EC or Directive 1999/13/EC. This impact assessment focuses on two specific markets where quality of finish is essentially more important than for the general timber industry, and potentially where there may be significant issues in terms of product performance; the furniture sector and the musical instrument sector. Both these sectors are particularly diverse involving a wide range of products and coating applications and involve both large and small companies.

The intended aim of the option is to limit choice to water-based products and other more recently emerging low-VOC technologies.

11.3.2. Impacts on Manufacturers

No information has been received from consultation regarding the potential number of manufacturers supplying wood coating products to the two sectors that would be affected by the proposed legislation. Reformulation will be required for some manufacturers, potentially requiring additional investments in research and development activities, although these could be reduced if sufficient time was allowed for manufacturers to incorporate the changes in VOC requirements into their own regular reformulation cycle.

11.3.3. Impacts on Professional Users

Furniture producers will be faced with a choice between investing in drying equipment to keep drying times down, or extending drying periods, which may require additional storage/drying space associated costs. Cost estimates for drying equipment from a Netherlands trade association include €10,000+ for water-soluble systems and UV driers for smaller companies, with the figures for large firms being approximately €50,000. UK estimates include costs of drying equipment in the region of €100,000 for small firms and €1 million for large firms at the 300g/l limit; these figures would double at the 100g/l limit. We have been unable to break these figures down further in terms of the quantity of furniture such equipment could dry in a given period, running costs, etc.

The UK competent authority and the UK member of UEA, the European Furniture Manufacturers Federation, both highlighted potential damage to the UK reproduction furniture industry from the need for manufacturing to move overseas in order to be able to gain access to the high VOC containing varnishes and coating materials needed for such furniture should these coatings no longer be available in Europe. A potential reduction in market share for the UK firms in the furniture sector could be from 70% to 30%. CEPE has also argued that the competitive position of European furniture manufacturers would be weakened if they did not have access to the same coating products as their overseas competitors.

SMEs are likely to be more affected by the measure than larger companies since they are less likely to have drying equipment in the first place. It was felt by the UK and Netherlands trade associations that start-up costs for new entrants to the market would increase by at least 5% at the 300g/l limit and by 10% or more at the 100g/l limit. However, it is noted also that CEPE indicated in their consultation response that they expected no significant increase in start-up costs for new entrants to the market.

With the exception of the very top performing products in terms of glossiness, scratch resistance etc, low VOC alternatives appear to exist already on the market. However, industry trade associations representing some high-quality furniture and musical instrument products make a strong case for exemptions to any limits similar to those proposed under this option, arguing that alternative products simply do not give an equivalent level of performance.

11.3.4. Impacts on Consumers

Impacts on consumers will be associated mainly with product performance. This will be restricted to certain categories where performance in terms of high-gloss, anti-scratch etc. are critical to the functioning of a product.

11.3.5. Impacts on Member State Authorities

Since there will be a number of new products coming into the scope of the directive which were previously outside its scope, surveillance agents in Member States will likely require some upgrading in their training. Additional costs might also be foreseen in terms of additional testing of the new products falling within the scope of the directive. A number of Member States have indicated that they would expect increases in their costs resulting from the option (note that some Member States responded generally, identifying additional costs under "new products", and where this is the case, it is expected that those Member States would incur costs under this option).

11.3.6. Environmental Benefit: Ground level ozone reduction and benefits of the ozone reduction

The implementation of the option will result in a reduction of anthropogenic VOC emission of approximately 57 ktons by 2020 in EU-27 plus Croatia and Turkey as it has been estimated in this report (details are represented in the annex). This may result in a marginal reduction of approximately 0.02% of the average ground level ozone concentration in EU-27+2 in 2020.

The expected benefits on human health have been estimated for 2020 to be approximately €12 million. Furthermore the ozone reduction may contribute to prevent part of the production losses due to crop damage. This has been quantified for 2020 with more then € 6.5 million.

11.3.7. Other Impacts on the Environment

Forced drying of water-based paints (and the consequent increase in energy consumption) and the fact that users may wash equipment with water and dispose of waste down the sink - although not state-of-art - have been identified by CEPE, UK and Netherlands-based trade associations as representing the most significant environmental risks that are likely to arise from the option. If enforced drying is used for water-based coatings, energy consumption and related air pollution can lead to relevant cross-media effects.

11.4. Summary table on impact assessment results

The following table sets out a scoring system for the envisaged major impacts likely to arise from implementation of these two options. The scores are based on the more detailed assessment of the options' impacts presented in Annex 7.

Table 27: Summary of Impact Assessment for scope extension to all wooden objects (Option 8)

Stakeholder Impact	Manufacturers	Professional Users	Consumers	Member State Authorities
Economic				
Capital/investment costs	-/?	--	0	n/a
Operating costs	Unknown	-	0	-/?
Product and raw material prices	Unknown	-	-	n/a
Imports/competitiveness	-/?	--	n/a	n/a
Competition	-/?	-	n/a	n/a
Entry costs	-/?	-	n/a	n/a
Innovation/research	-/?	0	n/a	n/a
Product performance	n/a	-- and - and 0 depending on product	-- and - and 0 depending on product	n/a
Monitoring/Surveillance costs	n/a	n/a	n/a	-/?
Social				
Employment	-/?	-/?	n/a	n/a
Health		+		
Environmental				
Cross media	-/?			
Waste and recycling	-/?			
Fuel consumption vehicle emissions	0			
Use of renewable/non-renewable resources	0			
Key: 0 = no impact +/- = uncertain impact positive or negative -/? = likely slightly negative impact but unquantifiable due to lack of data + = Positive impact ++ = Strongly positive impact - = Negative impact -- = Strongly negative impact				

12. Potential scope extension covering protective coatings (Option 9)

12.1. Description of the option

Option 9: Protective coatings are covered by Directive 2004/42/EC as far as they are decorative coatings used for buildings, their trims and fittings and associated structures. Protective coatings have a much wider application field.

CEPE has made a proposal to include 7 new categories of protective coatings into the scope of the directive, mainly aiming at a harmonized implementation of Directive 2004/42/EC avoiding different interpretations of the scope. Secondly a VOC reduction potential of 5.2 tonnes per year is expected.

The project team will assess the impact of the CEPE proposal, also assessing technical possibilities to further reduce the proposed VOC limit values or to include additional categories for water-based product groups.

12.2. VOC reduction potential and reduction scenario

The project team assessed data provided by CEPE to estimate the reduction potential of Option 9 independently from the results estimated by CEPE. The results differ according to the average VOC content assumed and are reflected in the different scenarios described below.

The table below shows several different VOC contents for protective coatings. The 3 first VOC contents were assumed to be valid for 2010, 2015 and 2020.

- First, the contents of current products were extracted from the data CEPE provided for the profile of the protective coatings sector.
- Second, different contents were also provided by CEPE and are assumed to present the current maximum levels.
- Third, the new regulations as proposed by the project team in collaboration with CEPE are shown.
- Additionally, another different set of VOC contents was provided by CEPE for a scenario of maximum technical feasible reduction (MTFR) for 2020.

The table below summarises the applied VOC contents.

Table 28: VOC contents applied for the estimation of reduction potential from inclusion of protective coatings (Option 9)

Product Subcategory		Average VOC content provided by CEPE	VOC limits provided by CEPE in comment	CEPE proposal for VOC limits from 2012 on	Additional VOC limits for 2020 MTFR from CEPE table
		[g/l]	[g/l]	[g/l]	[g/l]
Multi-pack primers and intermediates		340	445	290	220
Zinc primers		460	570	460	370
1-pack primers and intermediates		450	550	420	360
Multi-pack finishes		350	480	420	350
1-pack finishes		440	540	440	380
Tank linings		152	470	370	152
Intumescent coatings	Solvent borne	302	440	440	302
	Water borne	100	No data (assump.: 140)	140	100

Data provided by CEPE for the “business-as-usual” (BAU) scenarios for 2010, 2015 and 2020, including VOC contents from the first column of the table above, was only aggregated to EU-15 and EU-25 level. This is also the case for the "maximum technical feasible reduction" (MTFR) scenario for 2020. For the other cases of VOC contents data for the EU-25 was extrapolated assuming the same ratio between both aggregates.

The extrapolation of data for the EU-27+2 for the years 2010, 2015 and 2020, data on national population from EuroStat haven been applied.

Furthermore, the MTFR scenario provided by CEPE shows a change in sales data for the year 2020 within two of the seven sub-categories. In order to get the estimates as close to this development as possible, sales data for the DECOPAINT-NEW scenario in 2020 have been adjusted relative to the “total” change in sales between the BAU and the MTFR scenario. These adjustments with respect to sales data have also been accomplished for the estimates in 2015 in order to reflect the development of the protective coatings market in the EU.

The estimations of reduction potentials refer to the differences in the VOC emissions between the two BAU scenarios and the DECOPAINT-NEW scenarios (scenarios a) and b) for each of the years.

- Scenario a) refers to the differences in VOC limit values between the CEPE/DECOPAINT proposal (column 3 of Table 29) and the average contents as they were provided by CEPE (column 1 of Table 29).
- Scenario b) compares the VOC emissions resulting from the proposed limit values of CEPE/DECOPAINT with the maximum VOC limits provided by CEPE (column 2 of Table 29).

Both scenarios have been calculated for 2010, 2015 and 2020. In addition, the VOC emissions for the BAU scenarios and the MTFR scenario for 2020 (scenario c) and d)) have been compared.

- In scenario c), the VOC emissions resulting from the MTFR limit values for VOC (column 4 of Table 29) have been compared to the emissions from the average contents as they were provided by CEPE (column 1 of Table 29).
- In scenario d) the VOC emissions of the MTFR limit values (column 4 of Table 29) were confronted with the VOC emissions resulting from the maximum VOC limits provided by CEPE (column 2 of Table 29).

The resulting reduction potentials for the EU-27 for 2010, 2015 and 2020 have been distributed among the Member States plus Croatia and Turkey in order to prepare a country-specific impact assessment of the proposed regulations. The national sector activity figures provided by CEPE were selected to be the parameters for this distribution. The national reduction potentials arising from these calculations are presented in the table below.[25]

From the table it can be seen that the highest reduction potential arises for the MTFR scenarios in 2020. Furthermore, a negative reduction potential is reported for the comparison of VOC emissions from the CEPE/DECOPAINT proposal and the average VOC limit values provided by CEPE (scenario a)). This negative value results from the fact that for some of the sub-categories presented in Table 29 (multi-pack finishes, tank linings and solvent-based intumescent coatings) the VOC limit values of the proposal are above the currently reported average VOC limit values.

[25] For the estimations of the reduction potential an emission factor of 0.95 was applied. Thus, not all of the VOC content is emitted but 5% of the VOC are assumed to remain in the container and are not released into the air. This factor is based on an agreement of experts during the compilation of the German emission inventory.

Table 29: VOC reduction potentials EU-27+2 from inclusion of protective coatings into the scope (option 9)

Country	2010		2015		2020			
	Scenario a) kt	Scenario b) kt	Scenario a) kt	Scenario b) kt	Scenario a) kt	Scenario b) kt	Scenario c) kt	Scenario d) kt
Austria	-0.009	0.044	0.008	0.062	0.003	0.051	0.179	0.227
Belgium	-0.011	0.056	0.011	0.079	0.004	0.065	0.228	0.290
Bulgaria	-0.007	0.036	0.007	0.051	0.002	0.041	0.145	0.184
Cyprus	-0.002	0.008	0.001	0.011	0.000	0.009	0.032	0.040
Czech Republic	-0.022	0.107	0.023	0.167	0.007	0.139	0.484	0.615
Denmark	-0.085	0.418	0.078	0.577	0.025	0.458	1.600	2.033
Estonia	-0.004	0.019	0.004	0.030	0.001	0.025	0.087	0.110
Finland	-0.011	0.056	0.011	0.078	0.003	0.064	0.225	0.286
France	-0.047	0.231	0.044	0.323	0.014	0.268	0.935	1.188
Germany	-0.009	0.044	0.008	0.061	0.003	0.051	0.177	0.225
Greece	-0.011	0.051	0.010	0.072	0.003	0.060	0.208	0.265
Hungary	-0.011	0.054	0.011	0.083	0.004	0.069	0.242	0.308
Ireland	-0.006	0.027	0.005	0.038	0.002	0.032	0.110	0.140
Italy	-0.034	0.166	0.031	0.233	0.010	0.193	0.674	0.856
Latvia	-0.003	0.015	0.003	0.024	0.001	0.020	0.070	0.089
Lithuania	-0.004	0.019	0.004	0.029	0.001	0.024	0.085	0.108
Luxemburg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Malta	-0.002	0.011	0.002	0.017	0.001	0.014	0.049	0.063
Netherlands	-0.021	0.102	0.019	0.142	0.006	0.118	0.411	0.523
Poland	-0.045	0.221	0.046	0.343	0.015	0.285	0.997	1.267
Portugal	-0.006	0.030	0.006	0.041	0.002	0.034	0.120	0.152
Romania	-0.021	0.101	0.019	0.143	0.006	0.116	0.406	0.516
Slovakia	-0.002	0.011	0.002	0.017	0.001	0.014	0.049	0.063
Slovenia	-0.003	0.017	0.004	0.026	0.001	0.022	0.076	0.097
Spain	-0.036	0.175	0.033	0.245	0.011	0.203	0.709	0.901
Sweden	-0.011	0.053	0.010	0.075	0.003	0.062	0.216	0.275
UK	-0.052	0.254	0.048	0.355	0.016	0.295	1.029	1.308
EU-27	-0.475	2.326	0.449	3.321	0.148	2.731	9.543	12.126
Croatia	-0.004	0.021	0.004	0.029	0.001	0.024	0.084	0.106
Turkey	-0.067	0.326	0.062	0.461	0.020	0.376	1.313	1.669

12.3. Summary of impact assessment including ozone reduction potential and cost-benefit analysis

The proposal assessed here was drawn up by CEPE and focuses on the inclusion of in-situ applications of seven categories of protective coatings into the scope of Directive 2004/42/EC. The details of the limits proposed by CEPE are given in Table 30 below.

Table 30: VOC Limits in Protective Coatings Proposed by CEPE for inclusion in annex II of Directive 2004/42/EC

	Product Sub-category	VOC limit (ready to use) – g/l
a	Multi-pack primers and intermediates	290
b	Zinc primers	460
c	1-pack primers and intermediates	420
d	Multi-pack finishes	420
e	1-pack finishes	440
f	Tank linings	370
g	Intumescent coatings (Solvent-borne)	440
	Intumescent coatings (Water-borne)	140

CEPE proposed to extend the exemption procedure available to Member States under Directive 2004/42/EC to cover so-called 'specialty applications' of protective coatings. This is proposed to be achieved by means of amending Article 3 of the existing Directive to give Member States the opportunity to exempt products for "highly specialised end uses where the cost and/or time required for the testing and approval process is disproportionate to the benefit gained, or where the consequences of product failure may compromise safety, health or the environment."

In addition, it was argued that to minimise impacts on coatings manufacturers, in particular SMEs, the proposed limits should only come into force following a transition period, with the date of entry into force suggested by CEPE being 2012.

12.3.1. Background Information on Protective Coatings

The protective coatings sector is specific in that some segments of this market require coatings to undergo approval procedures before they become acceptable for some purchasers with some customers choosing products from lists of approved coatings only.

12.3.2. Expected Impacts of the Proposed Option (General Introduction)

Responses on expected impacts of the proposed option were received from Member State authorities (BG, CY, CZ, EE, EL, ES, HU, IE, RO, SI), CEPE (European paint manufacturers association), AVNH (Czech Association of Paint Manufaturers) and from companies.

CEPE provided data comparing actual (2003) VOC levels with proposed limits. This data show that the proposed limits are lower that the 2003 maximum levels indicating that there are products on the market that would not comply with the proposal. However, CEPE notes that there has been a substantial decline in average VOC contents since 2003 but no data on the proportion of products that would presently not comply with the proposed limits are available.

The input from AVNH (Association of Paint Manufacturers of the Czech Republic) notes that paint manufacturers in the Czech Republic produce paints in all categories detailed under this proposal and the VOC content in current products in general exceeds the proposed limits.

Consultation with manufacturers identified two companies manufacturing different types of protective coatings falling under almost all categories listed in the proposal, but currently offering compliant products only in one category. The companies are situated in Latvia and Poland, one of them medium-sized and the other one large.

12.3.3. Impact on public authorities

Member State authorities were asked to estimate the anticipated impact of the proposals relating to the inclusion of seven categories of protective coatings into the scope of Directive 2004/42/EC. Most of the Member States that responded to consultation believe that the proposal would result in an increase in monitoring and surveillance costs, albeit this increase would be lower than 'strong.' During consultation with Member State authorities prior to the publication of the interim report for this study, four Member States reported having experienced problems due to the exclusion of protective coatings from the scope of the Directive. Thus, it is possible that some Member State authorities may see reduced administrative burden if the proposal did succeed in eliminating current problems.

12.3.4. Impacts on manufacturers

According to CEPE, the cost of investing into additional production equipment is estimated to be minimal. However, manufacturers would incur costs due to the need for reformulation of existing products and testing and approval of new products. Overall, CEPE notes that the protective coatings sector would have to reformulate a "large and important part" of existing products. AVNH provided expert estimates of the costs that would be incurred by paint manufacturers in the Czech Republic. These estimates are based on the experience gathered in the course of the implementation of existing provisions stemming from Directive 2004/42/EC. The results are detailed in Table 31 below.

CEPE has contacted AVNH to receive details of the estimation. As AVNH did not provide a method consolidating the estimation, CEPE considers the cost data "subjective estimates with a significant extent of uncertainty". [Warnon, 2009]

Table 31: Estimated costs for implementation of option 9 incurred by Czech manufacturers of protective coatings

Type of cost	Cost incurred by producers in CZ (€ million)	Estimated costs in EU-27[1] (€ million)
Reformulation	1.15 - 1.8	117.3 - 183.6
Testing and re-approval	0.75	76.5
Cost of advertising new products	0.75	76.5
Stranded assets	0.8 - 1.2	81.6 - 122.4
Total	3.45 - 4.5	351.9 - 459
Notes: 1) Extrapolated from data on the Czech Republic based on GDP (current price)		

AVNH (July 2009), Eurostat Pocketbooks: Key figures on Europe 2007/2008.

However, it should be noted that the above extrapolation does not take into account any potential differences between the Czech Republic and other Member States. CEPE commented that the "extrapolation of the Czech data to the whole European area cannot be correct" and does "not recommend extrapolating data from a small national market to the whole EU-27". [Warnon, 2009]

CEPE estimates that the impact of the measure on imports and exports would be minimal if the proposal is restricted to in-situ applications only. CEPE envisages “very slight” impact on start-up costs for new market entrants.

Several anticipated impacts on paint manufacturers have been highlighted by CEPE, including the following:

- higher solids products will require more expensive raw materials leading to higher production costs;
- higher solids products imply higher viscosity and as such the dispersion of pigments is more difficult leading to longer processing times and associated higher costs (such as energy costs); and
- new products will necessitate lower application rates (volume per area) which is likely to result in lower paint consumption thus reducing economies of scale in the manufacturing process.

However, no quantification of the degree of these impacts was attempted by CEPE.

It was noted by CEPE that manufacturers would incur costs due to product withdrawal and re-labelling but this cost burden could be minimised by means of a transition period for the measure coming into place. The length of such a period is suggested to be two years, with a one year transition period deemed too short. However, the costs of such label changes could be minimised by harmonising these requirements with those introduced by the Classification, Labelling and Packaging Regulation, due to come into force for mixtures in June 2015.

AVNH expects a negative impact on profitability of companies with knock-on effects on exports and employment, in particular employment in small companies.

SMEs are likely to be affected to a different degree by some of the expected impacts and CEPE's suggestion to delay the coming into force of the proposal is based on their consideration of impacts on SMEs.[26]

12.3.5. Impacts on consumers and professional users

It is expected that the price of protective coatings will increase but due to the characteristics of compliant paints, it will be possible to apply lower paint volumes. However, it is not clear whether this will only mitigate or wholly off-set the impact that price increase will have on end-users.

A minority of professional end-users are expected to need additional application equipment. The measure may have a significant impact on end-users due to the fact that they may have to learn to use compliant products which may be more difficult to apply as a thin layer. In addition, some compliant products may be slower drying which may have an impact on the productivity of professional users.

Due to associated costs, AVNH expects a reduction of consumer choice with worst case scenario seeing 20 - 30% of current production not complying with the proposed limits and not being replaced with compliant products.

12.3.6. Ground level ozone reduction and benefits of the ozone reduction

The implementation of the option will result in a reduction of anthropogenic VOC emission of up to 3 ktons (scenario b) by 2020 in EU-27 plus Croatia and Turkey as it has been estimated in this report (details are represented in the annex). This may result in a marginal reduction of up to 0.001% of the average ground level ozone concentration in EU-27+2 in 2020.

The expected benefits on human health have been estimated for 2020 to be more then €550,000. Furthermore the ozone reduction may contribute to prevent part of the production losses due to crop damage. This has been quantified for 2020 with approximately €250,000.

Details of the calculation can be found in annex 9 on page 111.

12.4. Summary table on impact assessment results

The following table sets out a scoring system for the envisaged major impacts likely to arise from implementation of these two options. The scores are based on the more detailed assessment of the options' impacts presented in annex 10 on page A-107.

[26] However, SMEs are generally not expected to be affected by the cost of product re-approval as few SMEs participate in segments of the market where customers chose products from approved lists only. However, it should be noted that SMEs will still have to comply with ISO, NORSOK and other standards.

Table 32: Summary Impact Assessment – Inclusion of protective coatings (Option 9)

Stakeholder / Impact	Manufacturers	Professional Users Consumers	Member State Authorities
Economic			
Capital/investment costs	-	-	
Operating costs	-	-/?	
Product and raw material prices	-	+/-	
Imports/competitiveness	0		
Competition	-		
Entry costs	0		
Product performance	0	0	
Monitoring/Surveillance costs			+/-
Social			
Employment	-/?	0	
Health			
Environmental			
Cross media	0		
Waste and recycling			
Fuel consumption vehicle emissions	+/?		
Use of renewable/non-renewable resources			
Key: 0 = no impact +/- = uncertain impact positive or negative -/? = likely slightly negative impact but unquantifiable due to lack of data + = Positive impact ++ = Strongly positive impact - = Negative impact -- = Strongly negative impact			

13. Potential scope extension covering solvent-based floor-covering adhesives (Option 11)

13.1. Introduction

Adhesives have been identified as a product group, in which VOC reduction may be significant and feasible. The total amount of VOC contained in adhesives was estimated with 265 kt of which at least 41 kt of VOC is emitted under 'uncontrolled' conditions (not regulated by Directive 1999/13/EC), mainly from adhesives used in the building sector. This equals 2.7 % of the total VOC emissions in category 3D 'Others' (1473 kt in 2006 in EU-27) [EEA, 2008a].

An assessment of the inclusion of adhesives into the scope of Directive 2004/42/EC was proposed to the consultants by several Member States.

The product group of adhesives is extremely versatile, involving over 110 different product categories [FEICA/ASC 2008]. One group consists of floor covering adhesives. Given the large surface areas covered, relatively large amounts are applied. Floor covering adhesives are used for bonding various materials:

- ´soft` floor coverings, such as carpet, cork, vinyl etc.
- ´hard` floor coverings, i.e. parquet in various types: massive wood, laminates, plywood ´underfloors` etc.

Solvent-based adhesive systems produce highest VOC emissions, having VOC contents ranging from 10 – < 100 %. Alternative systems have little VOC content (< 5 % in water-based products) or use VOC for the reaction of the product (0 - 10 % in reactive products). Furthermore, VOC-free hotmelt systems can be an alternative in some cases, in particular for bonding of curved floorings when fast-drying is needed.

Market trends show remarkable decrease of solvent-based systems in some countries, in particular when motivated by initiatives to improve indoor air quality and occupational health. The voluntary "EMICODE" classification system has been introduced successfully in Germany, leading to a share of solvent-based adhesives of 7 %. Due to the low price and the easy applicability, it was expected that consumption of solvent-based adhesive systems may increase in future, especially where weak occupational health regulations are in place.

National regulations exist only in The Netherlands, where a VOC-limit of 5 g/kg (0.5%) for *indoor* floor covering adhesives is in force since 2000 (also regulating products for pretreatment like for leveling products or watersealing primers). No major problems have been reported. However, in particular the bonding of soft floor coverings on stairs required the definition of careful work practices; guidance on appropriate product selection was useful

Technical alternatives

Substitutes for solvent-based adhesives on specific flooring material include:

For soft flooring (carpets):

- Water-based dispersions (for most applications on 'flat' surfaces) ;
- Hotmelts (sprayable ; on staircases) ;
- Double-sided tapes, nails etc. (stairs).

For wooden flooring:

- Water-based dispersions: various types, e.g. with varying solids content;
- 1-pack polyurethanes (moisture-curing);
- 2-pack polyurethanes (isocyanate-curing);
- 1-pack MS-Polymer adhesives (moisture-curing)

Specific problematic areas were addressed by FEICA and the British adhesive suppliers association [FEICA, 2009a], [BASA, 2009]. These include:

1. Curved substrates and substrates under tension, in which immediate bonding is required that is now provided by high-VOC contact adhesives in many cases;

2. Outdoor bonding and bonding in non-heated buildings, in which in particular water-based adhesives may dry very slowly.

The first problem may be solved by using sprayable hotmelts, or combinations of strong double-sided tapes (initial bonding) and water-based contact adhesives (long-term bond). The second problem may be solved by using 2-component polyurethanes.

See annex 11 on page A-123 for detailed technical background information.

13.2. Description of the option

Option 11: The project team has assessed the impact of including solvent-based floor covering adhesives into the scope of Directive 2004/42/EC, setting a VOC-limit value for this product group of 5 g/kg.

Detailed results of the impact assessment are shown in annex 12 (page A-135).

Alternatively (as suggested by stakeholders) substitution can be achieved by simple description of the adhesive system to be substituted, preferably following the definition of EN 923:2006 in number 2.1.7:
Solvent-borne adhesive; solution adhesive; solvent based adhesive
"*Adhesive in which the binder is dissolved in a volatile organic solvent"*

13.3. VOC reduction potential and reduction scenario

Evaluations based on FEICA data show a current VOC reduction potential of 22.2 kt by substitution of solvent-based adhesives with alternative systems. This equals 1.5 % of total VOC emissions in category 3D 'Others' (1473 kt in 2006 in EU-27) [EEA, 2008a].

Data collection was difficult, and had to be extrapolated for 6 Member States. Detailed data showed varying VOC content in solvent-based flooring adhesives, ranging from 10 % to 80 %. For all countries a general VOC content of 40 % was assumed, except for Germany and UK where detailed VOC data was made available by national associations (25 % in Germany, 80 % in UK).

Future VOC reduction potential of 2015 and 2020 was developed assuming a constant annually growth rate, based on data of FEICA for the development between 2004 and 2007. The distribution of this total VOC reduction potential was calculated using national population data for each country provided by Eu-roStat, except data for Germany and the UK due to availability of detailed data.

Table 33: VOC emission reduction potential in EU-27+2 resulting from substitution of solvent-based floor covering adhesives (option 11)

Country	2015	2020
	kt	kt
Austria	0.41	0.40
Belgium	0.53	0.52
Bulgaria	0.36	0.33
Cyprus	0.04	0.04
Czech Republic	0.51	0.48
Denmark	0.27	0.26
Estonia	0.06	0.06
Finland	0.26	0.25
France	3.10	3.00
Germany	1.20	1.15
Greece	0.55	0.53
Hungary	0.48	0.45
Ireland	0.24	0.25
Italy	2.94	2.81
Latvia	0.11	0.10
Lithuania	0.16	0.15
Luxemburg	0.03	0.03
Malta	0.02	0.02
Netherlands	0.81	0.77
Poland	1.84	1.73
Portugal	0.53	0.51
Romania	1.02	0.95
Slovakia	0.26	0.25
Slovenia	0.10	0.09
Spain	2.38	2.34
Sweden	0.46	0.45
UK	2.13	2.04
EU-27	20.79	19.95
Croatia	0.26	0.25
Turkey	4.14	3.97

Table 33 summarises the reduction potentials for each of the countries and presents the total reduction potential in EU-27 for 2015 and 2020. The difference to the 22.2 kt of VOC reduction potential estimated for 2007 results from the application of the constant annually growth rate, based of a market data slightly declining between 2004 and 2007.

The expected VOC emission reduction of about 20 kt per year is equal to a share of 1.3 % of current VOC emissions in category D ('Other solvent use'), reported for 2006 from EU-27 Member States [EEA, 2008a].

13.4. Summary of impact assessment including ozone reduction potential and cost-benefit analysis

13.4.1. Stakeholder Suggestions for Changing the Proposal

Two consultees (FEICA and BASA) have made suggestions for amendment of the proposed option, mainly due to the fact that they would prefer the focus of the option to be defined by using the EN 923:2006 standard and that there is a need to establish exemptions for applications where alternative adhesive systems do not provide comparable performance.

FEICA forwarded a number of suggestions for amendment of the proposal. These suggestions relate to the following issues:

- FEICA proposes to delete the 5 g/kg limit and to restrict the option to a description of solvent-based adhesive systems according to number 2.1.7 of EN 923:2006 which would require substitution;
- FEICA proposes to restrict the applicability of the proposal to non-humid environments at 20ºC;
- FEICA finds that in some applications where fast-drying is needed, in particular where an initial tack is not available or where substrates are not air-permeable, alternative adhesive systems would not provide sufficient performance compared with solvent-based adhesives, and thus would need to establish exemptions from the proposal for certain applications, including curved floorings, skirting and cove bases and other curved surfaces, and rubber or PVC baseboards, homogenous-heterogeneous PVC, cushion vinyl and non-porous substrate, such as metal.

The project team agrees with the first suggestion and acknowledges the climatic disadvantages of non-solvent-based systems. On the other hand althernative systems like reactive adhesives can be used (less sensitive to climate) if ambient conditions are extreme (see climatic effects in Table 34 below). Climatic effects for bonding are relative because flooring materials (in particular wood) also need at certain temperature and humidity conditions for laying.

To evaluate the necessity of exemptions, an in-depth study on the experience of Dutch professional floor layers could be executed. Evaluations of the project team in The Netherlands have not revealed unresolvable problems.

13.4.2. Impact on Manufacturers and Suppliers

Information was only received from Germany and UK (IVK, BASA). Both assumed that very few manufacturers would rely exclusively on the production of solvent-based adhesives.

IVK does not expect that the proposal would require additional investment; BASA expects UK manufacturers to incur additional (unquantified) investment costs due to changes in manufacturing facilities and in educating end-users.

Imports and exports seem to account for only a very small proportion of production in Germany and the UK, according to IVK and BASA, indicating about 2-3% export to non-EU countries. SMEs are expected to discontinue exports while large companies in Germany are expected to relocate some production.

In all likelihood, the measure would not lead to any manufacturers leaving the flooring adhesives sector in Germany or the UK. However, it was noted that SMEs (~90%) are likely to be most adversely affected as they tend to be more specialised than larger companies (BASA). Implications across the supply chain due to diminished demand for solvents are not expected to be significant (IVK, BASA).

13.4.3. Impact on Professional Users

FEICA and BASA expect that the measure would lead to a completely substitution of solvent-based flooring adhesives by other adhesive systems and non-adhesive fixing solutions (such as nailing and floating flooring).

FEICA/BASA propose that certain types of flooring applications are exempted from this proposal as no alternatives with comparable performance exist (see above). However, the project team presumes that combinations of double sided tapes (initial tack) and water-based contact adhesives (durability of the bond) can provide satisfactory results [Terwoert, 2005], but labour time may increase.

FEICA and BASA also stress that certain conditions would be needed to use alternative products when substituting solvent-based products. Table 34 specifies the impact of temperature and humidity on drying time of various adhesive systems. It shows availability of sufficient alternative systems in case of substitution of solvent-based products, if not facing extreme ambient conditions.

Table 34: Impact of temperature and humidity on drying (curing) time of various adhesive types

Type of adhesive	Impact of temperature on curing time (High-medium-low)	Impact of humidity on curing time (High-medium-low)
Solvent-based	Low	Low
Polymer dispersions and emulsions	High	High
Reactive systems	Medium/high (medium) [1]	Medium/high (medium) [1]
Hot melts	Medium/high	Medium/high
Natural polymers	High	High
Water-soluble polymers	High (medium) [1]	High (medium) [1]
Other	Medium/high	Medium/high
Source: Consultation responses by IVK, BASA Notes: 1) Source is SPP only.		

FEICA elaborated on the functional disadvantages of alternatives to solvent-based systems being more dependent on certain climatic conditions, also highlighting that the use of hot-melts for flooring applications is uncommon in most countries due to difficulties associated with their application. The consultant team concludes that these difficulties seem to be resolvable because in The Netherlands, where a limit is in place for nearly 10 years, major difficulties have not been reported. Similarly, floor layers' associations in Germany and Poland (ZVPF and SPP) note that alternatives to solvent-based flooring adhesives offer satisfactory performance in all applications.

These discrepancies may be explained by varying building practices in EU Member States, e.g. carrying out flooring work in new buildings in UK under non-heated conditions.

Several issues in relation to the productivity of professional users were raised but could not be verified by the project team.

13.4.4. Impacts on Member State authorities

In summary, most Member States that provided a response believe that the proposed option would bring about an increase in monitoring costs but not at a strong level. The Irish authorities noted that initial familiarisation with the product and the market and the relevant distribution costs will be required but potential increased costs are anticipated to be relatively low.

13.4.5. Ground level ozone reduction and benefits of the ozone reduction

The implementation of the option will result in a reduction of anthropogenic VOC emissions of ~24 ktons by 2020 in EU-27 plus Croatia and Turkey (see Table 107 on page A-143). This may result in a marginal reduction of up to 0.008 % of the average ground level ozone concentration in EU-27+2 in 2020 (see annex chapter 12.5.1 on page A-148).

The expected benefits on human health have been estimated for 2020 to be more then €4.4 million in EU-27+2. Furthermore the ozone reduction may contribute to prevent part of the production losses due to crop damage. This has been quantified for 2020 with approximately €2.0 million.

13.5. Summary table on impact assessment results

Table 35 provides a summary of the main impacts of Option 11.

Table 35: Summary of Impacts from Inclusion of Floor Covering Adhesives (Option 11)

Stakeholder Impact	Manufacturers	Professional Users	Member State Authorities
Economic			
Capital/investment costs	-/?	-/?	
Operating costs		-	
Product and raw material prices			
Imports/exports	-/?		
Competition	0		
Innovation/research	0		
Product perform-ance/productivity		-	
Monitoring/Surveillance costs			-
Social			
Employment	-	0	
Health		++	
Environmental			
Cross media	0		
Waste and recycling	0		
Fuel consumption vehicle emis-sions	0		
Use of renewable/non-renewable resources	0		
Key: 0 = no impact +/- = uncertain impact positive or negative -/? = likely slightly negative impact but unquantifiable due to lack of data + = Positive impact ++ = Strongly positive impact - = Negative impact -- = Strongly negative impact			

14. Potential scope extension covering deodorants/antiperspirants (Option 12a)

14.1. Description of the option

Option 12a: First evaluations have shown that in the cosmetics sector the highest VOC reduction potentials can be realised if VOC reduction in hairsprays and deodorants is achieved. At the same time there have been clear indications that a reduction of the VOC content in hairsprays below about 90 % would reduce the performance. The ban of aerosol products would mean a strong impact on cultural habits and user preferances. Substitution of aerosols by compressed gas is an emerging technique.

The project team will assess the technical feasibility of VOC reduction of hair sprays, limiting the VOC content with 90 %. The project team will also assess the technical feasibility of VOC reduction from deodorants by limiting the VOC content of these products with 10 %. At present, this would mean that only emulsion-based rollers and sticks would be allowed on the market, as technical alternatives to high-VOC aerosol or pump-sprays are not available yet.

The project team will also assess the impact of an extension of the scope to all cosmetic products by introducing the obligation to have a clearly visible label on the front stating the VOC content, to raise consumer awareness and to facilitate consumers' choice when preferring VOC-reduced products.

14.2. VOC reduction potential and reduction scenario

The identification of the potential VOC reductions resulting from a ban of aerosol-based deodorants and antiperspirants is based on data provided by FEA and Colipa. The data covers current market statistics as well as existing average VOC contents for all relevant product types of deodorants and antiperspirants.

As data provided by stakeholders showed the situation at EU-27 level only, it had been agreed between parties to distribute these figures across countries using national population data provided by EuroStat. Furthermore, industry experts suggested the application of different per capita consumption rates to distinguish between old and new Member States.

The stated figures for the EU-27 of about 175 kt were scaled up to almost 190 kt for the EU-27+2 based on national population data.

For the estimation of the reduction potential of the implementation of a VOC limit of 10% - involving the removal of all aerosol-based product types of deodorants and antiperspirants from the market – two scenarios of substitution effects have been regarded in agreement with stakeholders. First, it has been assumed that only 20% of the current output of aerosol-based deodorants and antiperspirants will be replaced by roll-ons or creams, resulting in a strong decline of the deodorant market (scenario a). Second, an assumption of 80% of sales being replaced by other product types has been applied (scenario b). It is assumed that 80% (20%) of the current consumers of deodorants and antiperspirants will not use these products anymore. These consumers might switch to parfumes or similar products with high VOC contents. However, this shift in consumption is not part of the present analysis. The consumers who are not shifting to other deodorants or antiperspirants are assumed to leave the market of deodorants and antiperspirants. These two scenarios are supposed to analyse the reduction potential of very different behaviours of consumers which might be the outcome of individual preferences and product loyality.

Furthermore, for both substitution scenarios, the choice of consumers between roll-ons and creams has been assumed to depend on current market shares of these products.

Both scenarios have been estimated for 2015 and 2020 and were compared to the respective “business-as-usual” (BAU) scenario where no regulatory interventions were assumed. For the extrapolation of current data to 2010, 2015 and 2020, a stable market development has been assumed. Therefore, the development of the market for deodorants and antiperspirants has been assumed to grow at the same pace as national population is assumed to develop according to EuroStat.

The resulting reduction potentials for each of the EU-27+2 countries can be found in Table 36.[27] As can be seen from the table, the reduction potential for the EU-27 varies between about 125 kt and 135 kt for both 2015 and 2020.

[27] For the estimations of the reduction potential an emission factor of 0.95 was applied. Thus, not all of the VOC content is emitted but 5% of the VOC are assumed to remain in the container and are not released into the air. This factor is based on an agreement of experts during the compilation of the German emission inventory.

Table 36: Reduction potentials for Option 12 a per country, in kt

Country	2015		2020	
	Scenario a) kt	Scenario b) kt	Scenario a) kt	Scenario b) kt
Austria	2.47	2.37	2.51	2.41
Belgium	3.19	3.06	3.26	3.13
Bulgaria	1.06	1.02	1.04	0.99
Cyprus	0.13	0.12	0.14	0.13
Czech Republic	1.51	1.45	1.52	1.46
Denmark	1.61	1.55	1.63	1.57
Estonia	0.19	0.18	0.19	0.18
Finland	1.56	1.50	1.58	1.52
France	18.49	17.76	18.90	18.15
Germany	23.58	22.64	23.46	22.54
Greece	3.31	3.17	3.33	3.20
Hungary	1.43	1.38	1.42	1.37
Ireland	1.46	1.40	1.56	1.49
Italy	17.55	16.85	17.69	16.99
Latvia	0.32	0.30	0.31	0.30
Lithuania	0.47	0.45	0.46	0.45
Luxemburg	0.15	0.14	0.16	0.15
Malta	0.06	0.06	0.06	0.06
Netherlands	4.81	4.62	4.87	4.67
Poland	5.48	5.26	5.47	5.25
Portugal	3.15	3.03	3.20	3.07
Romania	3.04	2.92	3.00	2.88
Slovakia	0.78	0.75	0.78	0.75
Slovenia	0.30	0.28	0.30	0.28
Spain	14.22	13.66	14.72	14.14
Sweden	2.76	2.65	2.84	2.73
UK	18.37	17.64	18.92	18.17
EU-27	131.46	126.25	133.31	128.02
Croatia	0.66	0.63	0.67	0.64
Turkey	10.33	9.92	10.45	10.04

14.3. Summary of impact assessment including ozone reduction potential and cost-benefit analysis

14.3.1. Background Information: Current Market and Impact of Option

For deodorants and antiperspirants, it was proposed to consider the impacts of introducing a 10% limit on VOC content (w/w).

The product group 'deodorants and antiperspirants' comprises several sub-categories with divisions reflecting either variances in the purpose of the product (deodorant vs. antiperspirant) or in the packaging and application format (aerosol spray, roll-on, stick, pump, cream). The distinction between a deodorant and an antiperspirant relates to the area of application (a deodorant can be applied to the whole of the body while an antiperspirant is normally intended for application in the underarm only)[28] and to the product's functional properties (unlike deodorants, antiperspirants reduce perspiration).

Table 37 summarises the relevant market information for the major product categories and details the expected impact of the proposal on the relevant products.

Table 37: Deodorants and antiperspirants and impact of proposed limit

Product format	No. of units sold annually (EU-27)	% of sales (no. of units)	Average VOC content (%)	Share of compliant products (% of total sales in each category)	Available as deodorant	Available as antiperspirant
Aerosol spray (deodorants)	549 228 000	25%	97	0%	Yes	-
Aerosol spray (antiperspirants)	671 279 000	30%	95	0%	-	Yes
Roll-on (alcohol-type)	52 204 000	2%	40-70	0%	Rare	Yes
Roll-on (emulsion-type)	467 808 000	21%	3-10	98%	No	Yes
Sticks	314 673 000	14%	35-50 (antiperspirants)	0%	Rare	Yes
Pumps	152 808 000	7%	<90	n/a	Yes	Yes
Creams/Gels	< 1% of market	1%	3-10		-	-

Various documents provided by Colipa/FEA and other sources

Table 37 suggests that the adoption of the proposed limit would have a large-scale impact on the current market, as several categories (aerosol-based sprays, alcohol-type roll-ons and stick antiperspirants) presently do not include any products that comply with the proposed limit. In addition, associations and other entities consulted for this study do not believe that development of compliant products in these categories is technically feasible in the medium-term (2-5 years). Thus, the proposed limit, if adopted immediately, is expected lead to the withdrawal from the market of products accounting for 72% of current sales

28 The consultants are also aware of products on the market that are antiperspirants aimed at use on feet.

(by number of units or value of sales). The major product group to remain on the market would thus be emulsion-type roll-ons.[29]

In addition, the division between deodorants and antiperspirants (as detailed in Table 37) within the various packaging formats indicates that the proposal would result in the withdrawal from the market of deodorants in all product formats. The only potential exception may be deodorant pumps sprays; however, only very limited information was obtained on the availability of deodorants within this product group.

Consultation input by Colipa/FEA suggests that the proposed measure may not entail a straightforward shift of consumer allegiances from non-compliant product formats to emulsion-type roll-ons but may lead to more complex changes in the market. Colipa/FEA suggest that compliant alternatives may suffer from a lack of consumer acceptance and consumers may thus turn to alternative personal care products and methods (increased washing and clothes washing or increased reliance on eau de toilete/perfume). This, in conjunction with other factors, such as lower quantity of emulsion roll-ons used per application, leads Colipa/FEA to contend that the proposed measure would result in a significant decline of the total deodorant/antiperspirant sales (by as much as one half).

While it is impossible to reliably quantify the impact of the proposal on the overall value of the market (several factors such as cultural habits or lack of social acceptance of not using personal care products would need to be taken into account), it is clear that if the value of the market were to decrease significantly, this may reduce or accelerate several economic, social and environmental impacts discussed later in this impact assessment. By way of example, the increased use of perfumes and eaux de toilette may negate any environmental benefits derived from reduced VOC emissions from deodorants/antiperspirants as maximum VOC content in perfumes has been indicated as 80%, see annex 54 [IVAM, 2005]. Data provided by Colipa/FEA indicate that typical VOC concentrations in eaux de toilette may be 75-80 % and the VOC content of perfumes may reach 100%.

14.3.2. Impacts on Manufacturers of Deodorants and Antiperspirants

There are some significant data gaps in relation to baseline indicators on the deodorant/antiperspirant production sector. This includes the fact that the number of companies active in this sector is unknown and the relative market shares of SMEs vs. large companies could not be determined. Consequently, it was not possible to quantify the precise number of firms that would be affected

29 Due to lack of information, the impact that the proposal on the pump spray segment is uncertain.

by the proposal or to quantify some of the impacts on the SME segment of this sector.[30]

Consultation conducted with associations of deodorant and antiperspirant manufacturers (Colipa/FEA and PZPK) indicates that, in order to comply with the proposal, manufacturers would need to invest in:

- increased production capacity for compliant alternatives;
- reformulation of existing emulsion-type rolls-ons in order to increase their attractiveness for former users of other products; and
- R&D efforts to develop new systems for non-compliant product formats.[31]

Colipa/FEA estimate investment into increasing production capacity of emulsion-type roll-ons is likely to be between €120-150 million while the costs of reformulation would amount to € tens of millions. In addition, the proposal is expected to lead to manufacturers of deodorants/antiperspirants incurring losses due to stranded assets of between € 250-300 million (based on the limit entering into force in 2014).

The study team estimates that the cost of capital investment and stranded assets may represent between 10% - 40% of 2014 annual sales by deodorant and antiperspirant manufacturers, assuming that the value of the EU market does not decline following the introduction of the measure. The above calculations are based on a number of assumptions that reflect worst-case scenarios for deodorant and antiperspirant manufacturers.[32] A key uncertainty in the ranges relates to a lack of information on the retail prices currently paid for end-products.

However, a certain proportion of the above costs would be incurred by cosmetics companies even in a scenario with no legislative intervention. A survey conducted for RPA (2007)[33] found that cosmetics companies replace or reformulate approximately 24% of their product formulations each year, suggesting that companies may completely reformulate or replace their product range approximately every four years, with the speed of product range replacement being faster for medium and large companies than for small enterprises (see Table 38).

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30 However, Colipa/FEA note that there are approximately 2,000 companies active within the European cosmetics sector, most of which are SMEs.

31 However, it was noted by consultees on several occasions that such systems could probably not be developed within the upcoming 2-5 years

32 These calculations are based entirely on data provided by Colipa/FEA and on the following scenarios: Average price per unit between €1-4 which was given for aerosols and roll-ons is assumed to apply for all product formats. Production data taken for EU-27 in 2007 was adjusted on the basis of a 1% annual growth rate until 2014 (Colipa/FEA estimate 0-2%), retailer mark-up assumed to be 30%, and exports are assumed to cease altogether following introduction of the measure (95-100% of companies would discontinue exports of non-compliant products). Capital investment costs assumed to total €249 million and stranded assets assumed to be €300 million.

33 RPA (2007): Impact of European Regulation on the EU Cosmetics Industry, Available from the European Commission Internet Site, http://ec.europa.eu/enterprise/cosmetics/doc/study_impact_eur_regul_cosmetics.pdf, Accessed on 15th May 2009

Table 38: Annual formulation replacement and reformulation rates in RPA (2007) survey (% of product formulations replaced or reformulated each year)

Company size	Lowest response (%)	Highest response (%)	Average (%)
Small	10	25	19
Medium	5	60	26
Large	10	50	25
All	5	60	24

RPA (2007)

Other costs indicated by consultees include increased market concentration, a negative impact on exports and a potential relocation of production to facilities outside the EU; these impacts are elaborated on in subsequent paragraphs.

Consultees expect the proposed measure to lead to increased market concentration and the presence of fewer brands on the market, thus significantly increasing start-up costs for new market entrants (this is due to higher costs of brand building and advertising). It is expected that large manufacturers' profit margins derived from production of emulsion-type roll-ons would increase but any gains would be off-set by the need to invest in reformulation; as a result, the overall profitability of most companies may decline, according to Colipa/FEA.

It is noted that aerosol filling is concentrated in several Member States (UK, Germany, the Netherlands, and France) and as a consequence these countries are likely to be affected by the proposal more than the other EU countries (Colipa/FEA). This has been partially confirmed by the study of AIC/BIPRO/DIFU [EC, 2002] which provides production data for various aerosol products in EU15 in 2000. These data indicate that the UK, Germany, and France were the largest producers of cosmetics aerosols. However, the report also suggests that aerosol production in the Netherlands mainly relates to non-cosmetic aerosols.

Presently, imports from non-EU countries account for less than 10% of EU sales; similarly, less than 15% of EU production (by value) is exported to external markets. Colipa/FEA and PZPK indicate a potential negative impact on EU's trade balance, with the proposed limit possibly leading to increased imports from low cost locations due to the fact that manufacture of roll-ons is technically less demanding. However, it was not possible to determine whether producers would relocate their production to lower cost locations within the EU or outside the EU.

14.3.3. Impacts Across the Supply Chain

According to Colipa/FEA, manufacturers of VOCs for use in deodorant and antiperspirant aerosols are not likely to be severely impacted as freed production capacity may be used to supply other sectors. Similarly, fragrance manufacturers are not expected to be significantly affected. However, consultees expect that the measure would create more significant problems for packaging suppliers (cans, valves, actuators), manufacturers of can making and aerosol filling equipment and materials, and in several other sectors throughout the supply chain.[34]

In particular, consultees highlighted the impact that the proposed measure is expected to have on can suppliers. AEROBAL (the International Association of Aluminium Aerosol Container Manufaturers) represents 18 European producers of aluminium cans with a total employment of 3,500 and an annual turnover of €510 million. AEROBAL's members are characterised by high reliance on supplying cosmetics manufacturers, with 50% of its output currently supplying deodorant/antiperspirant production (AEROBAL). AEROBAL expects proposed measures relating to hairsprays and deodorants/antiperspirants to lead to 'many' businesses going out of operation.

AEROBAL collected information from a number of aluminium can manufacturers and from selected machine and slug producers and provided the consultants with estimates of job losses that these companies expect to incur as a result of Option 12a (deodorants/antiperspirants) and Option 12b (hairsprays). AEROBAL expects a loss of 3000 jobs in 18 companies surveyed in the aluminium can manufacturing sector, 500 jobs in the three surveyed machine suppliers and 500 jobs in the nine companies surveyed in the slug supplying sector. This indicates a potential total job loss of 4000, not including other segments of the supply chain, where, according to AEROBAL, substantial job losses are to be expected as well.

In support of the above data, AEROBAL highlights the high dependence of aluminium aerosol can makers on this business activity, high capital intensive nature of this sector and no potential for the relevant manufacturing equipment to be used for other types of production. In addition, it was noted that the surveyed machine and slug producers are in turn dependent to a critical degree on the aerosol aluminium can manufacturing sector.

It should be noted that the above proposals are based on a scenario modelling the loss of the deodorant/antiperspirant and hairspray market for these producers while as discussed further in the Chapter on hairsprays, Option 12b does not amount to the withdrawal from the market of aerosol hairsprays.

However, AEROBAL does not represent the entire aerosol can sector. By means of example, several members of the Metal Packaging Manufacturers Association are engaged in the production of aerosol cans.

Colipa/FEA estimate that substantial losses would be incurred within the supply chain with stranded assets by can and valve suppliers estimated at €300-400 million.

34 The sectors that were indicated include aluminium slug making plants, ink and lacquer suppliers, and repro houses.

14.3.4. Impacts on Consumers

The main impacts that the proposed measure may have on consumers relate to potential changes in the retail price paid for end-products, anticipated reduction in consumer choice and comparatively worse functional performance of compliant alternatives.

It has not been possible to quantify the expected impact on retail prices of deodorants and antiperspirants; however, consultation responses by Colipa/FEA and AEROBAL indicate several types of expected impacts:

- upward pressure on price due to diminished market competition and the need to recover investments in stranded assets; and
- downward pressure on price due to lower rates of innovation,[35] higher profit margins on emulsion-type roll-ons and relocation of production to low-cost countries.

In relation to the expected impacts on consumers, it is clear that consumer choice would be narrowed down to fewer application formats. In addition, Colipa/FEA suggest that consumers would be faced with inferior performance characteristics of the compliant alternatives, such as:

- emulsion-type roll-on, unlike aerosol products, is based on contact application and thus cannot be shared among several users;
- roll-ons, creams, water-based pump sprays are seen as slower-drying, wetter and stickier than aerosols;
- deodorant aerosols are used as bodysprays while antiperspirant roll-ons can only be applied to the underarm;
- aerosol sprays allow for uniform and continuous application which cannot be provided by pump sprays; and
- performance of fragrances in deodorants/antiperspirants is negatively impacted by water-based formulations and contact application.

On the other hand, it has been noted that roll-ons on average last longer before becoming empty and as such offer a longer-lasting solution to the consumer.[36]

14.3.5. Impact on Member State Authorities

Member State authorities were requested to assess the expected impact of the proposals relating to cosmetic products on monitoring and surveillance costs. The results are summarised in Table 39 (please note that Member State re-

[35] Consultants assume that innovation here refers to long-term innovation, which may be narrowed down to innovation within the emulsion-type roll-on segment.

36 Average roll-on lasts for 50-70 days before becoming empty while average aerosol unit lasts only 30-40 days.

sponses in Table 39 relate to proposal on deodorants/antiperspirants as well as to the proposal on hairsprays).

Table 39: Anticipated increase/decrease of surveillance and monitoring costs incurred by Member State authorities due to Options 12a, 12b, and 12c

Member State	Change in monitoring and surveillance cost
Bulgaria	+
Czech Republic	+
Cyprus	++
Estonia	+
Hungary	+
Greece	0
Ireland	++
Romania	++
Slovenia	++
Spain	+
Key: Member States were asked to rate the expected increase/decrease of surveillance and monitoring costs on a scale --, -, 0, +, ++, i.e. ranging between a strong reduction of the average costs to a strong increase.	

It is of note that four out of ten responding Member States expect a strong increase in monitoring costs and a further five expect an increase. The Irish authorities point out that cosmetic products share little in common with products currently within the scope of Directive 2004/42/EC and, as such, the authorities would incur costs due to the need to conduct initial research on the sector and on the relevant distribution channels.

Colipa/FEA expect a decrease in tax revenues drawn by all 27 EU Member States (€200-250 million) but no other information underpinning this figure was provided; as such, it is impossible to determine what assumptions (such as market scenarios) this figure is based on.

14.3.6. Ground level ozone reduction and associated benefits of the ozone reduction

The implementation of the option will result in a reduction of anthropogenic VOC emission of around 140 ktons by 2020 in EU-27 plus Croatia and Turkey as it has been estimated in this report (details are represented in the annex). This may result in a marginal reduction of 0.04% of the average ground level ozone concentration in EU-27+2 in 2020.

The expected benefits on human health have been estimated for 2020 to be more then €27.5 million for the second and more then €28.5 million for the first scenario. Furthermore the ozone reduction may contribute to prevent part of the production losses due to crop damage. This has been quantified for 2020 with approximately €14.5 million.

14.4. Summary table on impact assessment results

Table 40 below summarises the main impacts of Option 12a.

Table 40: Option 12a - Summary of Impacts

Impact/Stake-holder	Manufacturers	Suppliers	Consumers	MS Authorities
Economic				
Capital/investment costs	--	--		
Operating costs	+			
Product and raw material prices	?	-	?	
Imports/competitiveness	-/?			
Competition	-/?			
Innovation/research	?			
Product performance			--	
Monitoring/Surveillance costs/Tax Revenue				-/? (tax revenue) -- (monitoring cost)
Social				
Employment	--	--		
Consumer choice			--	
Environmental				
Cross media		-/?		
Waste and recycling		-		
Fuel consumption vehicle emissions		+/-		
Use of renewable/non-renewable resources		+/-		

Key:
0 = no impact
+/- = uncertain impact positive or negative
-/? = likely slightly negative impact but unquantifiable due to lack of data
+ = Positive impact
++ = Strongly positive impact
- = Negative impact
-- = Strongly negative impact
Note: Member State monitoring costs refer to Options 12a, 12b and 12c being adopted simultaneously.

15. Potential scope extension covering hairsprays (Option 12b)

15.1. Description of the option

Option 12b: First evaluations have shown that in the cosmetics sector the highest VOC reduction potentials can be realised if VOC reduction in hairsprays and deodorants is achieved. At the same time there have been clear indications that a reduction of the VOC content in hairsprays below about 90 % would reduce the performance. The ban of aerosol products would mean a strong impact on cultural habits and user preferances. Substitution of aerosols by compressed gas is an emerging technique.

The project team will assess the technical feasibility of VOC reduction of hair sprays, limiting the VOC content with 90 %. The project team will also assess the technical feasibility of VOC reduction from deodorants by limiting the VOC content of these products with 10 %. At present, this would mean that only emulsion-based rollers and sticks would be allowed on the market, as technical alternatives to high-VOC aerosol or pump-sprays are not available yet.

The project team will also assess the impact of an extension of the scope to all cosmetic products by introducing the obligation to have a clearly visible label on the front stating the VOC content, to raise consumer awareness and to facilitate consumers' choice when preferring VOC-reduced products.

15.2. VOC reduction potential and reduction scenario

The estimations of reduction potentials for the countries of the EU-27+2 are based on data provided by FEA and Colipa. The figures comprise information on current market shares, output and existing average VOC contents.

As data provided by stakeholders showed the situation at EU-27 level only, it had been agreed between parties to distribute these figures across countries using national population data provided by EuroStat. Furthermore, industry experts suggested the application of different per capita consumption rates to distinguish between old and new Member States.

The stated figures for the EU-27 of about 112 kt were scaled up to almost 122 kt for the EU-27+2 based on national population data. It has been estimated that about 109 kt represent aerosol-based sprays and 3 kt are pump hairsprays.

The data provided by FEA and Colipa includes data on average VOC contents of the different product types. For aerosol-based sprays an average content of 95% was provided. Additionally, the sales of products with less than 90% VOC have been reported to be between 5% and 10%. Analogously, for pumps the average content has been stated to range between 90% and 95% with about 50% to 70% of sales containing more than 90% of VOC. For the estimations of the reduction potentials for each country a two major assumptions have been made. First, the new limit of 90% only affects 90% of the sales of aerosol-based sprays while 10% of sales already contain less than 90% of VOC. Second, a share of 60% of sales of pumps has been assumed to contain more than 90% of VOC while 40% already fulfil the requested limit.

Table 41: VOC reduction potential in EU-27+2 from scope extension to hairspray (Option 12b)

Country	2015	2020
	kt	kt
Austria	0.09	0.09
Belgium	0.12	0.12
Bulgaria	0.04	0.04
Cyprus	0.00	0.01
Czech Republic	0.06	0.06
Denmark	0.06	0.06
Estonia	0.01	0.01
Finland	0.06	0.06
France	0.69	0.71
Germany	0.88	0.88
Greece	0.12	0.12
Hungary	0.05	0.05
Ireland	0.05	0.06
Italy	0.66	0.66
Latvia	0.01	0.01
Lithuania	0.02	0.02
Luxemburg	0.01	0.01
Malta	0.00	0.00
Netherlands	0.18	0.18
Poland	0.21	0.20
Portugal	0.12	0.12
Romania	0.11	0.11
Slovakia	0.03	0.03
Slovenia	0.01	0.01
Spain	0.53	0.55
Sweden	0.10	0.11
UK	0.69	0.71
EU-27	4.92	4.99
Croatia	0.02	0.02
Turkey	0.39	0.39

The analysis covers scenarios for 2015 and 2020. The extrapolation of sales data for these future years is based on the development of population growth as estimated by EuroStat. For each year the scenario of a reduction of VOC contents to 90% was compared to a “business-as-usual” (BAU) scenario with no regulatory interventions.

The reduction potentials that have been estimated for each of the EU-27+2 countries are shown in the table above.[37] For 2020, an overall reduction potential of about 5 kt was estimated.

15.3. Summary of impact assessment including ozone reduction potential and cost-benefit analysis

15.3.1. Background Information: Current Market and Impact of Option

Presently, the hairspray market includes two product formats: aerosol hairsprays and pump hairsprays. The proposed limit would apply to both product types. Table 42 below provides background data relating to the two hairspray formats and the anticipated impact of the proposal.

Table 42: Background data on hairsprays and impact of proposed limit

Hairspray type	Production (units produced in EU-27 in 2007)	Average VOC content (%)	Relative market shares (aerosol vs. pump)	Sales of products with VOC content of 90% or lower (% of total sales in relevant Category)
Aerosol	556,570,000	95%	94-95%	5-10%
Pump	28,000,000	80-95%[1]	5-6%	-
Notes: 1) Typical values 90-95%				

Various documents provided by Colipa/FEA

Table 42, which is based on Colipa/FEA data, indicates that approximately 90-95% of aerosol hairsprays that are currently on the market exceed the proposed limit, while the proportion of non-compliant pump hairsprays is unknown. By contrast, consultation input provided by PZPK suggests that various hair aerosols may contain a range of VOC contents but that these do not usually exceed 90%. The reason for this discrepancy is not known.

The limit proposed for hairsprays is not expected to lead to replacement of aerosols with alternative product formats and rather necessitates reformulation of existing products, with both product formats being affected. While Table 42 indicates that the average content in some pump hairsprays may be as low as

[37] For the estimations of the reduction potential an emission factor of 0.95 was applied. Thus, not all of the VOC content is emitted but 5% of the VOC are assumed to remain in the container and are not released into the air. This factor is based on an agreement of experts during the compilation of the German emission inventory.

80%, if the typical VOC content values are between 90-95% (as indicated by Colipa/FEA), then a proportion of pump hairsprays may need to be reformulated to meet the proposed limit. Reformulation entails replacement of the liquefied propellant (VOC) with alcohol, thus, leading to a very small or even a zero net VOC reduction. As a result, the market share of pump sprays is not expected to increase following adoption of proposed measure.[38]

15.3.2. Impact on Manufacturers

The number of companies engaged in EU-based hairspray production is not known and consequently the number of companies that may be affected by the proposal could not be determined; however, it is estimated that 90% of companies producing aerosol hairsprays are currently producing non-compliant products.

In their consultation response, Colipa and FEA estimate that the cost of investment incurred by manufacturers due to product reformulation[39] and due to the anticipated need to use DME[40] may be as high as €1 million per each product brand, with the exact value depending on the number of formulations sold under each brand. However, while the estimate was provided on a per brand basis, data on hairspray aerosol brands that are currently on the market (and on the number of formulations within each brand) are not collected by Colipa/FEA and as such could not be provided to the consultants.

The timeframe needed by companies to reformulate a product is estimated at three years.[41] In addition, it is noted that hairsprays have a three year shelf life suggesting that the necessary adjustment time may need to be longer than the three years required for reformulation.

However, it is of note that cosmetics companies reformulate their products on an ongoing basis (see chapter on deodorants for more information) and as a result some reformulation costs would also be incurred in a scenario with no legislative intervention. In addition, it seems that the industry may have some degree of experience with the use of DME as an aerosol propellant. AFC/BiPRO/DFIU [EC, 2002] noted that in addition to propanebutane, DME was a common propellant used in aerosols and has solvent properties that are 'desirable' in some aerosol product formulations (e.g. hairsprays).

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38 Pump sprays have some important functional disadvantages in comparison with aerosols as they cannot deliver as controllable and constant spray patterns and instead deliver larger particles and necessitate a longer drying time.

39 Compliant products are already available but they may not meet requirements of former users of high-VOC products. According to Colipa/FEA, product reformulation would entail: development of new product formulation and efficacy and safety assessments, development of suitable containers and valves, etc., process development and scale up, standard development, stability and consumer acceptance tests, testing of new formulation and its can compatibility, artwork change.

40 DME would be used as propellant as current propellants are not compatible with water. DME has different properties from liquefied propane/butane (used currently as propellant) and as consequence, gaskets and aerosol filling equipment would have to be redesigned. In addition, cans may need protective layer to prevent corrosion.

41 This relates to the minimum time needed to launch a new product detailed by Colipa/FEA.

Colipa/FEA envisage a small increase in start-up costs for new market entrants (between 1 - 2.5%) but further explanation of why this is expected is required. Profit margins of compliant alternatives are expected to be lower due to higher packaging and raw material costs[42] and due to an expected lower demand from the professional sector.

As indicated earlier, aerosol filling is concentrated in several Member States (UK, Germany, the Netherlands, and France) and the impact of this option is likely to be larger in these countries when compared with other Member States (Colipa/FEA) (although the Netherlands is unlikely to be affected to the same degree as aerosol production may be dominated by non-cosmetic products).

At present, the import of hairsprays into the EU is reported to be insignificant, while relatively large quantities of hairsprays are exported (estimated by Colipa/FEA at 5-30% of the value of EU-based production). It is suggested that companies would not find it possible to manage dual production of compliant products for the EU market and non-compliant products for external markets. At the same time, due to poorer performance properties, products with less than 90% VOC content may not be accepted in external markets. These factors lead Colipa/FEA to report a potential for relocation of some production to facilities outside the EU.

15.3.3. Impact on Suppliers

It is expected that companies across the supply chain would be impacted by the proposal. Product reformulation is expected to lead to changes in the raw material supply chain, in particular due to propane-butane in hairspray formulations being replaced by DME, thus impacting on suppliers of these chemicals (Colipa/FEA).[43]

While the proposed option is expected to affect manufacturers of aerosol cans, the impacts are expected to be somewhat different from those previously reported for Option 12a (deodorants/antiperspirants). This is due to the fact that hairsprays account for a smaller proportion of aluminium can manufacturers' output than deodorants/antiperspirants (AEROBAL notes that all hair care products including hairsprays, hair mousses, etc. account for 20% of the sector's unit sales) and due to the fact that while a decline in hairspray sales is expected, this does not amount to a withdrawal of all aerosols from the market as was the case with Option 12a. However, it is anticipated that aerosol can manufacturers may be required to adjust their production processes to include an internal protective lacquer in the can in order to prevent corrosion that may be caused by increased water content in products compliant with the proposed limit.

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42 As noted later in this Section, DME is reported to be 50% more expensive than propane/butane.

43 The use of DME may also reduce the use of ethanol. Switch from liquefied gas to compressed gas may also increase the need for other solvents. Liquefied gases act as co-solvents. There may also be changes in the use of particular resins and perfumes as these may presently be tailored for propane/butane-based mixtures.

15.3.4. Impact on Consumers and Professional Users

The main impacts on consumers and professional users are expected to stem from a potential loss of performance advantages specific to products with VOC content exceeding 90% and from a potential increase in the retail price of hair-sprays.

Colipa/FEA argue that lowering VOC content below 90% may result in the loss of some of the functional advantages offered by higher-VOC products. It is argued that compliant products may be characterised by a wet feel on application and by diminished capacity to 'hold the style.' Impacts due to potential loss of functional properties are expected to affect the consumer as well as the professional market, with negative implications for professional applications stressed by Colipa/FEA.

In relation to consumer use, it is of note that Colipa/FEA quote a study that found that 12 – 18% of men and 34 – 50% of women in Europe use hairsprays at least once weekly. Therefore, any potential loss of functional properties of hairsprays may be felt by a significant proportion of the European populace. These percentages seem high and it is not clear to what age groups they apply and to what product groups; further details of the study would be required to verify these figures.

In the professional market, Colipa/FEA expect the proposed option to result in a drop in total sales as compliant alternatives do not offer the same functional properties, and in particular quick drying properties. Colipa/FEA emphasise that for professional applications, the use of quick-drying and fine-spraying hair-sprays is indispensable to achieving special styling techniques. AFC/BiPRO/DFIU [EC, 2002] also confirms functional disadvantages of water-based products, which may have a long drying time and may 'destroy' the hair-style.

It is also noted by Colipa/FEA that some alternative hair styling products (mouse/foam aerosols, gels and waxes, liquid lotions, creams, gels and waxes) may not be suitable substitutes as they are intended for a different target group; by means of example, they may not be suitable for long hair.

In addition, it is expected that the use of DME instead of propane/butane will increase unit production cost by 15%[44] and Colipa/FEA argue that this increase will be reflected in end-product price. However, the change in price of alternatives to non-compliant products is envisaged by Colipa/FEA to be between 1-2.5%, possibly indicating that in fact not the whole increase in production cost would be passed onto the consumer or that the increase in unit production costs would only represent a relative small percentage of total per unit costs (when other costs aspects are included).

[44] DME is reported to be 50% more expensive than propane/butane.

15.3.5. Ground level ozone reduction and benefits of the ozone reduction

The implementation of the option will result in a reduction of anthropogenic VOC emission of approximately 5 ktons by 2020 in EU-27 plus Croatia and Turkey as it has been estimated in this report (details are represented in the annex). This may result in a marginal reduction of 0.002% of the average ground level ozone concentration in EU-27+2 in 2020.

The expected benefits on human health have been estimated for 2020 to be approximately €1 million. Furthermore the ozone reduction may contribute to prevent part of the production losses due to crop damage. This has been quantified for 2020 with approximately €500,000.

15.4. Summary table on impact assessment results

Table 43 provides a summary of the main impacts of Option 12b.

Table 43: Option 12b - Summary of Impacts

Stakeholder Impact	Manufactur-ers	Professional Users	Consumers	Member State Authorities
Economic				
Capital/investment costs	-			
Operating costs	-			
Product and raw material prices	--	-	-	
Imports/exports	-			
Competition	- (SMEs)			
Innovation/research				
Product performance		--	-	
Monitoring/Surveillance costs				--
Environmental				
Cross media	-/?			
Waste and recycling	0			
Fuel consumption vehicle emissions	0			
Use of renewable/non-renewable resources	+/-			

Key:
0 = no impact
+/- = uncertain impact positive or negative
-/? = likely slightly negative impact but unquantifiable due to lack of data
+ = Positive impact
++ = Strongly positive impact
- = Negative impact
-- = Strongly negative impact
Note:
Member State monitoring costs refer to Options 12a, 12b and 12c being adopted simultaneously.

16. Introduction of compulsory labelling stating the VOC content in deodorants/antiperspirants and hairsprays (Option 12c)

16.1. Describtion of the option

Option considers the introduction of an obligation for producers of deodorants/antiperspirants and hairsprays to place a clearly visible label stating VOC content on the front of each product.

Current labeling requirements for cosmetic products arise from Article 6 of the Cosmetics Directive (Directive 76/768/EEC). In addition, aerosol products are subject to labeling requirements stemming from the Aerosol Dispenser Directive (Directive 75/324/EEC).[45] Article 6(g) of Directive 76/768/EEC[46] also requires cosmetic products to detail the list of their ingredients, in descending order of weight at the time they are added, with ingredients representing less than 1% by weight being allowed to be listed in any order at the end of the list.[47] Ingredient listings use the International Nomenclature of Cosmetic Ingredients (INCI) which aims to provide a harmonized name for each cosmetics ingredient (RPA, 2007). No quantitative information on chemical composition has to be given on the packaging of the product. According to Colipa/FEA, Directive 76/768/EEC also provides for on-demand access to more detailed information, including selected quantitative information.[48]

However, it is doubtful that current labeling requirements can be seen as an effective tool in allowing (or influencing) the consumer to purchase a low-VOC product as quantitative information on VOC content is currently not available at the point of purchase. The study team is also not aware of any voluntary labeling of VOC content in cosmetics and no such examples were raised by consulted industrial associations. The current proposal can thus be seen as representing a step change in offering consumers environmentally relevant information that is currently unavailable to them at the point of purchase.

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45 Aerosol Dispenser Directive (Directive 75/324/EEC) as amended by amended by Directive 94/1/EC and Directive 2008/47/EC.
46 Directive 76/768/EEC consolidated version including amendments up to April 2008. Available from the EurLex Internet Site, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1976L0768:20080424:EN:PDF , Accessed on 15th May 2009
47 Article 6(g) of Directive 76/768/EEC also allows "materials used in strictly necessary quantities as solvents or ascarriers for perfume and aromatic compositions" not to be listed.
48 According to Colipa/FEA, such information may be obtained via a dedicated Internet site http://www.european-cosmetics.info. However, the consultants have not been able to locate the information on this Internet site.

While consultation on labeling deodorants and antiperspirants was conducted separately from that for labeling hairsprays, the responses provided by consultees were broadly similar for both product groups and they are presented here jointly.

16.2. VOC reduction potential and reduction scenario

The identification of the potential VOC reductions resulting from compulsory labelling of aerosol-based deodorants/antiperspirants and hairsprays is based on detailed data provided by FEA and Colipa. The data applied for the estimations refer to those figures FEA and Colipa provided for options 12a and 12b. Therefore, the distribution among countries using population data and the extension of data provided for the EU-27 Member States to the EU-27 plus Croatia and Turkey are analogous to the above-mentioned description.

Furthermore, the projection of current data for the years 2010, 2015 and 2020 followed the identical approach as described above using data on population development provided by EuroStat.

The reduction potential for each country of the EU-27+2 was estimated comparing the VOC emissions from a “business-as-usual” (BAU) scenario without regulatory changes and four different DECOPAINT-NEW scenarios where the effect of re-labelling of the different products has been analysed.

For the DECOPAINT-NEW scenarios, data on sales has been extrapolated analogously to the BAU scenario. Again, the time for implementing new regulatory measures in 2010 has been assumed to be too short and no estimation of possible reduction effects in VOC emissions has been estimated.

For 2015 and 2020 the implementation of compulsory labelling of products stating the VOC content has been analysed. The main assumption underlying these assumptions refers to the change in consumer behaviour. It has been assumed that the statement of high VOC contents will lead to a shift of consumption to products including lower amounts of VOC. This shift was assumed to affect current consumption to a certain percentage. Four different scenarios have been regarded: a shift in consumption by 10% (scenario a)), 20% (scenario b)), 30% (scenario c)) and 40% (scenario d)). For hairspray products these assumption mean a shift by 10%, 20%, 30% or 40% away from products with 95% VOC to products with 90% or less VOC. For deodorants the assumption leads to a 10%, 20%, 30% or 40% decrease in consumption of aerosol-based spray deodorants and antiperspirants as well a as a decrease in demand for sticks and pumps. These decreases are absorbed by increasing consumption of alcohol-type and emulsion-type roll-ons. The demand for creams and gels has been assumed to remain stable.

The following table shows the reduction potential of this labelling option for each of the EU-27 Member States plus Turkey and Croatia.[49]

Table 44: VOC reduction potentials from compulsory labelling of products (Option 12c)

Country	2015				2020			
	scenario a)	scenario b)	scenario c)	scenario d)	scenario a)	scenario b)	scenario c)	scenario d)
	kt	kt	kt	kt	kt	kt	kt	kt
Austria	0.18	0.36	0.54	0.72	0.18	0.37	0.55	0.74
Belgium	0.23	0.47	0.70	0.93	0.24	0.48	0.72	0.96
Bulgaria	0.08	0.16	0.23	0.31	0.08	0.15	0.23	0.30
Cyprus	0.01	0.02	0.03	0.04	0.01	0.02	0.03	0.04
Czech Republic	0.11	0.22	0.33	0.44	0.11	0.22	0.33	0.45
Denmark	1.73	3.46	5.18	6.91	1.72	3.44	5.16	6.88
Estonia	0.01	0.03	0.04	0.06	0.01	0.03	0.04	0.06
Finland	0.11	0.23	0.34	0.46	0.12	0.23	0.35	0.46
France	1.36	2.71	4.07	5.42	1.39	2.77	4.16	5.54
Germany	0.12	0.24	0.35	0.47	0.12	0.24	0.36	0.48
Greece	0.24	0.48	0.73	0.97	0.24	0.49	0.73	0.98
Hungary	0.11	0.21	0.32	0.42	0.10	0.21	0.31	0.42
Ireland	0.11	0.21	0.32	0.43	0.11	0.23	0.34	0.46
Italy	1.29	2.57	3.86	5.15	1.30	2.59	3.89	5.19
Latvia	0.02	0.05	0.07	0.09	0.02	0.05	0.07	0.09
Lithuania	0.03	0.07	0.10	0.14	0.03	0.07	0.10	0.14
Luxemburg	0.01	0.02	0.03	0.04	0.01	0.02	0.03	0.05
Malta	0.00	0.01	0.01	0.02	0.00	0.01	0.01	0.02
Netherlands	0.35	0.71	1.06	1.41	0.36	0.71	1.07	1.43
Poland	0.40	0.80	1.21	1.61	0.40	0.80	1.20	1.60
Portugal	0.23	0.46	0.69	0.92	0.23	0.47	0.70	0.94
Romania	0.22	0.45	0.67	0.89	0.22	0.44	0.66	0.88
Slovakia	0.06	0.11	0.17	0.23	0.06	0.11	0.17	0.23
Slovenia	0.02	0.04	0.07	0.09	0.02	0.04	0.07	0.09
Spain	1.04	2.09	3.13	4.17	1.08	2.16	3.24	4.32
Sweden	0.20	0.40	0.61	0.81	0.21	0.42	0.62	0.83
UK	1.35	2.69	4.04	5.39	1.39	2.77	4.16	5.55
EU-27	9.64	19.27	28.91	38.55	9.77	19.55	29.32	39.09
Croatia	0.05	0.10	0.14	0.19	0.05	0.10	0.15	0.20
Turkey	0.76	1.51	2.27	3.03	0.77	1.53	2.30	3.07

16.2.1. Impact on Manufacturers

The response provided by Colipa/FEA indicates that, provided a sufficient transition period is included in the legislation, costs of labelling may be negligible to

[49] The reduction potentials are based on the assumption of an emission factor of 0.95. The factor says that not all of the VOC content is emitted but 5% of the VOC remain in the container and are not released into the air. This factor was agreed by experts during the compilation of the German emission inventory.

manufacturers. It was noted that it was unlikely that labelling costs would force companies to discontinue production or significantly increase start-up costs for new market entrants.

The costs that would arise from this option include artwork development, measurement of VOC content, and development and production of different language versions of the label. It is noted that for the vast majority of products, inclusion of a VOC label would only be possible after removing existing text, in particular if this option were to introduce a requirement for the label to include a narrative statement.

PZPK estimates that labelling change may result in a one-off cost of between €500 – 1000 per product[50] indicating that the total cost for each company depends on the size of its product range. Due to the need to produce different language versions of the label, the overall cost may also depend on the geographical area to which a company's products are distributed (this would not apply if legislation required a symbol-based label only). Again, however, it must be recognised that labels are changed on a regular basis and that companies can minimise costs by managing changes in artwork etc to correspond with changes in marketing and promotional activities.

Consultees highlighted three further issues. These include a disproportionate impact on SMEs (further elaboration of why this may be the case is required) and the need for this option to be based on a widely agreed method of determination of VOC content. In addition, Colipa/FEA suggest that due to limited space on cosmetics labels, multi-country labels will have to be replaced by more country-specific labels and in some cases the associated costs may result in companies withdrawing a product from certain Member States; however, no examples of countries that may be affected by this were provided.

16.2.2. Impact on Consumers

While the proposed measure would give consumers the means to base their purchases on environmental considerations, Colipa/FEA note that additional information may overburden the label and confuse the consumer. In this respect, it was suggested that a symbol-based label would be preferable to a narrative-based label.

16.2.3. Environmental Impact: Ground level ozone reduction and benefits of the ozone reduction

The implementation of the option will result in a reduction of anthropogenic VOC emission in a range of 10 to 40 ktons by 2020 in EU-27 plus Croatia and Turkey as it has been estimated in this report (details are represented in annex 4.5 on

50 Upon clarification with PZPK, the study team concluded that the term 'product' equates to a 'formulation.'

page A-52). This may result in a marginal reduction of 0.004% and 0.015% of the average ground level ozone concentration in EU-27+2 in 2020.

The expected benefits on human health have been estimated for 2020 to be approximately between €1.9 million and €7.8 million. Furthermore the ozone reduction may contribute to prevent part of the production losses due to crop damage. This has been quantified for 2020 with approximately €1.0 million to €4.0 million.

16.3. Summary table on impact assessment results

Table 45 below summarises the main impacts of Option 12c.

Table 45: Option 12c - Summary of Impacts

Stakeholder Impact	Manufacturers	Consumers	Member State Authorities
Economic			
Capital/investment costs	-		
Operating costs	-		
Product and raw material prices	-	0	
Imports/competitiveness	0		
Monitoring/Surveillance costs			--
Social			
Employment	0		
Consumer Choice		++ (VOC informa-tion) - (product unavailable in some Member States)	
Environmental			
Cross media	0		
Waste and recycling	0		
Fuel consumption vehicle emis-sions	0		
Use of renewable/non-renewable resources	0		
Key: 0 = no impact +/- = uncertain impact positive or negative -/? = likely slightly negative impact but unquantifiable due to lack of data + = Positive impact ++ = Strongly positive impact	- = Negative impact -- = Strongly negative impact *Note:* Member State monitoring costs refer to Options 12a, 12b and 12c being adopted simultaneously.		

17. Potential scope extension covering glass and window cleaners (Option 13)

17.1. Description of the option

Option 13: First evaluations have shown that window cleaners are effective if the VOC content is < 5 % or even < 3 %.

The project team will assess the impacts of an inclusion of window cleaners into the scope of the directive combined with a VOC limit value of 3 % or 5 %.

17.2. Summary of expected VOC reduction potential and reduction scenario description

For the estimation of the reduction potential in VOC emissions as a result of reducing the VOC content in window cleaners to 5% or 3%, the project team assessed data provided by A.I.S.E.

In a first step, data for those countries not covered by the A.I.S.E figures were estimated applying population data provided by EuroStat. This approach allowed for an extrapolation of the original data to the EU-27+2 levels. The amount of 158 kt of output for the EU-27 was extrapolated to 182 kt for the EU-27+2.

In agreement with A.I.S.E, the average VOC content for these existing outputs was assumed to be 8%. Furthermore, A.I.S.E stated a slow market growth for the sector and a high likeliness of VOC contents to decrease for the time period considered in the analysis. To account for these inputs the development of the market for window cleaners was assumed to follow national population growth figures estimated by EuroStat.

The estimations of potential reductions in VOC emissions were based on three scenarios. First, “business-as-usual” (BAU) scenarios for 2015 and 2020 were estimated where VOC limits are not further regulated and population growth serves as base for market development. Second, for 2015 and 2020 two scenarios were estimated with a) a regulated VOC limit of 5% and b) a regulated VOC limit of 3%. The reduction potential for each of the scenarios results from a comparison of VOC emissions estimated for the BAU scenario and the scenarios a) and b).

Table 46 provides an overview of the reduction potential of the two scenarios for the years 2015 and 2020.[51] As shown in the table, the reduction potential for the EU-27+2 varies between 2.5 kt and 5.6 kt for both 2015 and 2020.

Table 46: VOC reduction potential in EU-27+2 from scope extension to glass and window cleaners (Option 13)

Country	2015		2020	
	Scenario a)	Scenario b)	Scenario a)	Scenario b)
	kt	kt	kt	kt
Austria	0.04	0.08	0.04	0.08
Belgium	0.05	0.10	0.05	0.11
Bulgaria	0.04	0.10	0.04	0.09
Cyprus	0.01	0.01	0.01	0.01
Czech Republic	0.03	0.07	0.03	0.07
Denmark	0.03	0.07	0.03	0.07
Estonia	0.01	0.02	0.01	0.02
Finland	0.03	0.07	0.03	0.07
France	0.24	0.51	0.25	0.52
Germany	0.38	0.81	0.38	0.80
Greece	0.08	0.16	0.08	0.16
Hungary	0.06	0.13	0.06	0.13
Ireland	0.03	0.07	0.03	0.07
Italy	0.37	0.78	0.37	0.79
Latvia	0.01	0.03	0.01	0.03
Lithuania	0.02	0.04	0.02	0.04
Luxemburg	0.00	0.01	0.00	0.01
Malta	0.00	0.01	0.00	0.01
Netherlands	0.07	0.14	0.07	0.14
Poland	0.19	0.41	0.19	0.41
Portugal	0.04	0.09	0.04	0.09
Romania	0.08	0.17	0.08	0.17
Slovakia	0.02	0.04	0.02	0.04
Slovenia	0.01	0.03	0.01	0.03
Spain	0.29	0.61	0.30	0.63
Sweden	0.06	0.12	0.06	0.13
UK	0.39	0.83	0.40	0.85
EU-27	2.59	5.51	2.62	5.58
Croatia	0.02	0.05	0.02	0.05
Turkey	0.36	0.78	0.37	0.79

[51] For the estimations of the reduction potential an emission factor of 0.95 was applied. Thus, not all of the VOC content is emitted but 5% of the VOC are assumed to remain in the container and are not released into the air. This factor is based on an agreement of experts during the compilation of the German emission inventory.

17.3. Summary of impact assessment including ozone reduction potential and cost-benefit analysis

17.3.1. Background Information: Current Market and Impact of Option

The International Association for Soaps, Detergents and Maintenance Products (A.I.S.E.) has estimated that approximately 42% of total EU sales of glass and window cleaning products (by volume, tons) contain greater than 5% VOCs. 58% therefore contain less than 5% VOC's and A.I.S.E. has estimated that 6% of products have a VOC content of less than 3%. It has not been possible to obtain information regarding the numbers of manufacturers in total in the sector, nor therefore on numbers producing window and glass cleaners at different VOC levels.

Generally, market growth in the sector appears relatively low and A.I.S.E. expects the VOC of products to remain constant or decrease slightly in the foreseeable future in the absence of any legislative measures. Whilst some glass and window cleaning products have been developed to meet the EU-wide eco-label, it is noted that this is a voluntary initiative; furthermore, the definition of VOC differs and the limits set under the initiative are higher than what is being proposed under this option.

17.3.2. Impacts on Manufacturers

Reformulation will be required for products which are currently non-compliant with the proposed limits under this option, although 58% of products are estimated to be already compliant (i.e. meaning that the technology is both possible and accessible). Overall costs for reformulation of products to meet the 5% limit should therefore be limited, given the anticipated long lead time to implementing the option in approximately 2015.

A.I.S.E. do anticipate however that the reformulation costs may be unaffordable for many SMEs, putting some at risk of having to leave the market with consequent (albeit at this stage indeterminate) effects on employment. The fact that many products are already compliant with the 5% limit would suggest though that such effects on employment may be limited if the option was introduced at this level. The association similarly estimates that start-up costs for the sector would also increase by approximately 2.5% - 5% if either of the VOC limits were introduced, although it is unclear what costs may increase for start-ups since the main impact of the measure appears to be the need to reformulate products.

Industry associations have not been able to provide estimates for the unit costs of reformulation. Given that only 6% are currently compliant with the 3% limit, reformulation costs will likely be more expensive if the option were introduced at this lower limit for VOC content. As SMEs are said to represent a large proportion of companies currently trading in products above both the 3% limit, it is likely that the option would affect SMEs to a greater extent.

EU producers' market share in Europe is estimated to be almost 100% by A.I.S.E.. It is not expected that the option would affect the current market share of EU producers as regards the internal market. Similarly, only approximately 2% of products manufactured in the EU are exported. As a result, it is not expected that the option would have any significant impact on exports and EU companies' ability to compete in global markets.

17.3.3. Impacts on Professional Users and Consumers

A.I.S.E. are of the view that glass and window cleaners with a VOC content below 3% are not technically feasible, and that those products which meet this limit deliver a significantly lower level of performance. However, as 58% of the market is made up of products with a VOC of less than 5%, then meeting this limit would not appear to pose significant performance penalties for most products.

The there may be specific cases though where the lower limits have an impact on the ability of products to meet certain performance requirements. A.I.S.E. provided the example of automotive window cleaners as requiring a VOC content of more than 60% in order to prevent freezing in the tank or on the window. However, automotive window cleaners are out of scope of option 13.

According to A.I.S.E., any effects on functionality/product performance may be more significant in Mediterranean countries due to the significantly higher use of glass and windows in buildings in these countries, although the extent of this effect is unclear.

Window cleaners would benefit from a reduction in VOC content in the products covered by the option, although employment figures for the sector and specifically those using the higher VOC content products have not been identified.

17.3.4. Impacts on Member State Authorities

Since there will be a number of new products coming under the scope of the directive, surveillance agents in Member States will likely require some upgrading in their training. Extra costs might also be arise in terms of additional testing of the new products falling within the scope of the directive. A number of Member States have indicated that they would expect increases in their costs resulting from the option. (Note that some Member States responded generally, identifying additional costs under "new products", and where this is the case, it is expected that those Member States would incur costs under this option.)

17.3.5. Impact on the Environment

Since 58% of products are already expected to be compliant with the 5% limits set down in the option, there are not expected to be significant environmental impacts associated with this limit. A.I.S.E. does predict though that a reduction to a 3% VOC limit might mean that users will "overdose" on the use of products in order to obtain the same cleaning performance and this would result in greater discharges to water through the sewage system.

Other active ingredients may also be used within products in order to achieve the same performance; A.I.S.E. have highlighted the potential use of surfactants as an alternative, with this leading to adverse environmental impacts with respect to pollution and inhibition of aeration in water. It is unknown to what extent such substitution might take place at either the 5% or 3% VOC limits proposed.

17.3.6. Ground level ozone reduction and benefits of the ozone reduction

The implementation of the option will result in a small reduction of anthropogenic VOC emission of 2.6 ktons for a VOC limit of 5% and 5.6 ktons for a VOC limit of 3% by 2020 in EU-27 plus Croatia and Turkey as it has been estimated in this report (details are represented in the annex). This may result in a marginal reduction of up to 0.002% of the average ground level ozone concentration in EU-27+2 in 2020.

The expected benefits on human health have been estimated for 2020 to be €500,000 for the first scenario up to more then €1 million for the second. Furthermore the ozone reduction may contribute to prevent part of the production losses due to crop damage. This has been quantified for 2020 with up to €600,000 for the second scenario with a VOC limit of 3%.

17.4. Summary of Impact Assessment

Table 47 sets out a scoring system for the envisaged major impacts likely to arise from implementation of this option. The scores are based on the more detailed assessment of the option’s impacts presented in annex 16 on page 221 and are illustrated for the 5% VOC limit option. At the 3% VOC limit, the strength of negative impacts is likely to be enhanced due to the fact that additional products would need to be reformulated.

Table 47: Summary Impact Assessment (at 5% VOC limit)

Stakeholder Impact	Manufacturers	Professional Users	Consumers	Member State Authorities
Economic				
Capital/investment costs	-/?	0	0	n/a
Operating costs	0	0	n/a	-/?
Product and raw material prices	0	0	0	n/a
Imports/competitiveness	0	n/a	n/a	n/a
Competition	- (for SMEs)	0	n/a	n/a
Entry costs	-/?	0	n/a	n/a
Innovation/research	-/?	0	n/a	n/a
Product performance	n/a	-/? or 0	-/? or 0	n/a
Monitoring/Surveillance costs	-	n/a	n/a	-/?
Social				
Employment	-/? or 0	0	n/a	n/a
Health				
Environmental				
Cross media	-/?			
Waste and recycling	0			
Fuel consumption vehicle emissions	0			
Use of renewable/non-renewable resources	Unknown			

Key:
0 = no impact
+/- = uncertain impact positive or negative
-/? = likely slightly negative impact but unquantifiable due to lack of data
+ = Positive impact
++ = Strongly positive impact
- = Negative impact
-- = Strongly negative impact

18. Potential scope extension covering aerosol-type insecticides (Option 14)

18.1. Extension of the scope for inclusion of aerosol-type insecticides

18.1.1. Description of the option

Option 14: First evaluations have shown that a ban of aerosol-type insecticides would reduce VOC emissions of this product group.

It is proposed quantify the VOC reduction potential, to assess the impacts of such a ban and to assess the feasibility of the technical alternatives, with a specific focus on health impacts of the systems.

18.1.2. Summary of expected VOC reduction potential and reduction scenario description

The project team was not able to derive a reduction potential based on current sales figures and existing VOC regulations as no data was provided by stakeholders that allowed for these estimations.

A.I.S.E. reported a reduction potential for the EU-27 of 4.8 kt resulting from a ban of aerosol-type insecticides. Based on this figure the potential reduction potential for the EU-27+2 countries was derived. As A.I.S.E. reports to cover 95% of the EU-27 market, data was scaled up to the total EU-27+2 market. The national reduction potentials were estimated applying national population data provided by EuroStat. From these calculations a total reduction potential for the EU-27+2 of 5.8 kt was estimated.

The estimations focus on the year 2015 only, as this year was assumed to be the earliest for the implementation of the regulation. Estimation for 2020 has not been accomplished due to lack of detailed market data.

Table 48 shows the estimated reduction potentials for each country of the EU-27 with a total reduction potential for 2015 of about 5 kt.

Table 48: VOC reduction potential in EU-27+2 from scope extension to insecticides (Option 14)

Country	2015
	kt
Austria	0.09
Belgium	0.11
Bulgaria	0.07
Cyprus	0.01
Czech Republic	0.10
Denmark	0.81
Estonia	0.01
Finland	0.05
France	0.64
Germany	0.06
Greece	0.11
Hungary	0.10
Ireland	0.05
Italy	0.61
Latvia	0.02
Lithuania	0.03
Luxemburg	0.01
Malta	0.00
Netherlands	0.17
Poland	0.38
Portugal	0.11
Romania	0.21
Slovakia	0.05
Slovenia	0.02
Spain	0.49
Sweden	0.10
UK	0.63
EU-27	5.05
Croatia	0.05
Turkey	0.71

18.2. Summary of impact assessment including ozone reduction potential and cost-benefit analysis

18.2.1. Summary of Consultation

We conducted consultation on the above proposal with interested stakeholders and received a joint response from A.I.S.E. (International Association for Soaps, Detergents and Maintenance Products) and FEA (European Aerosol Federation). The joint statement by these two associations argued that household insect-control products should not be subject to limits on VOC content.

18.2.2. Functional advantages of VOCs in insect-control products

A technical briefing paper on aerosol insect-control products was provided to the consultants by A.I.S.E. and FEA. This paper highlights public health benefits of insect-control products in fighting diseases such as malaria, Lyme's disease and chikungunya, and in controlling and repelling a variety of insects and pests, such as flying and crawling insects, house dust mites, fleas and ticks, wasps and hornets, etc. It is also argued that some of the above mentioned diseases may in the future occur with an increased incidence in Europe as a result of climate change and that insect-control products are important to counter such diseases.

According to A.I.S.E./FEA, the purpose of VOCs in household insect-control products is:

- to cut through the insect's waxy coat thus improving efficacy of the insect-control product;
- to act as solvent;
- to act as a propellant and provide stable pressure in the product thus ensuring constant delivery throughout product life;
- to ensure delivery of appropriate particle sizes thus increasing effectiveness of the product (this functionality cannot be delivered by non-aerosol products).

In addition, A.I.S.E./FEA note that aerosol-type products have a number of functional advantages, such as no direct contact with hands taking place on application thus preventing hand to mouth transmission of substances in the product and, in case of personal insect repellents, aerosols providing even and easy application.

It was argued by A.I.S.E./FEA that the above functional advantages would be lost if household aerosol insect-control products were to be withdrawn from the market. In addition, it was stated that the health impacts of insect-control products are already regulated by means of the Biocidal Products Directive (Directive 98/8/EC).

18.2.3. Ground level ozone reduction and benefits of the ozone reduction

The implementation of the option will result in a small reduction of anthropogenic VOC emission of around 5 ktons by 2015 in EU-27 plus Croatia and Turkey as it has been estimated in this report. This may result in a marginal reduction of 0.002% of the average ground level ozone concentration in EU-27+2 in 2015.

The expected benefits on human health have been estimated for 2015 to be approximately €1 million. Furthermore the ozone reduction may contribute to prevent part of the production losses due to crop damage. This has been quantified for 2015 with approximately €500,000.

19. Potential scope extension covering marine coatings (Option 15)

19.1. Description of the option

Option 15: First assessments have not revealed data on VOC reduction potential. The project team has further assessed the VOC reduction potential of the sector to decide whether an inclusion of the marine coating sector into the scope of Directive 2004/42/EC is recommended.

Consultations of EURMIG and CEPE showed that the boat and yacht coating sector is mainly covered by Directive 1999/13/EC. A few Member States have implemented lower threshold values on the sector, which results in additional activities being coverd by the regulations of Directive 1999/13/EC.

Based on the information received about the low VOC reduction potential and the restricted technical options for alternative coating systems, it was decided not to undertake a complete impact assessment on the option.

19.2. Summary of the assessment

The sector of Marine Coatings covers the application of paints on ships with a length over 25 meters and with a commercial purpose. The coatings in the Marine Coatings scope are applied either on newly built craft or for maintenance and repair purposes.

Pleasure boats e.g. yachts are another market segment and differ by the people that apply the paints and by the types and functions of the paints.

In the EU 27, approximately 450 ship yards exist, whereof 85 % exceed the solvent consumption threshold of Directive 1999/13/EC. Austria, Italy and Slovenia have implied a national solvent consumption threshold of 0.5 t/a.

CEPE estimates that there are about 70 marine shipyards remaining which are not covered by requirements under Directive 1999/13/EC. Based on the most conservative approach that these installations have a solvent consumption of nearly 5 tons per year, the total VOC emission would sum up with 350 tons, equivalent to about 750 tons of coatings (50 % average solvent content). Currently the technical feasibility for application of high-solid coating systems would lead to a VOC reduction of maximum several tens of tons per year.

CEPE argues that product development and market introduction activities for such products are in the magnitude of 500,000 € per one type of paint. If reductions over all 3 types of paints would have to be made this would sum up to 1,500,000 €. The relevant paint volumes via which these costs will have to be paid back would be too small to make this investment economical.

EURMIG argues that the do-it-yourself (DIY) market for yachts is small. VOC emissions from the DIY sector for yachts equate to 4.05% relative to the total for Marine and yacht combined.

19.2.1. VOC emissions of marine coatings

Table 49 shows the VOC emissions from marine and yacht coating, based on IIASA figures of 2005 (74,530 t/a). Based on comments and assumptions of EURMIG, the total solvents of coatings used for small yacht builders not covered by Directive 1999/13/EC and for DIY sector sum up with 4.06 kt/a. Assuming a maximum theoretical VOC reduction potential of 50 – 80 %, a VOC reduction of 2.0 – 3.2 kt can be achieved.

Table 49: VOC reduction potential in EU-27+2 from scope extension to marine cowati gs (Option 15)

VOC emission	**[IIASA 2005]**					**Comments/assumptions of EURMIG**
Marine+Yacht	**74530 t/a**	**100,0%**				
Yacht industry	**11530 t/a**	**15,47%**	100,0%			
Unregulated	**690 t/a**	**0,93%**	6,0%			
IT+SI+AT volume	**2306 t/a**		**20%**			**National threshold is 500 kg/a => all under SED**
Not IT+SI+AT vol.	**9224 t/a**		**80%**	**100%**		
A. Super yachts, R&M	3228 t/a			**35%**		**Each site at least 15 kt => all under SED**
B. Small yacht builders	**3228 t/a**	**4,3%**		**35%**	**100%**	**60% consume more than 5 kt => under SED**
whereof non-SED b)	1291 t/a	**1,7%**			**40%**	**small yacht builders, not under SED**
C. 'Do it yourself' DIY	2767 t/a	**3,7%**		**30%**	**100%**	
whereof regulated a)	1384 t/a				**50%**	**Regulated by National and Local rules, following SED**
whereof regulated b)	692 t/a				**25%**	**Regulated by specific environmental permits for yacht clubs**
whereof non-regulated	692 t/a	**0,93%**			**25%**	**Unregulated**
1. Reduction potential						
		Assumed reduction				
B. Small yacht builders b)	1291 t/a	50%	646 t/a			High-solvent content => High solid coatings
C. DIY regulated a)	1384 t/a	50%	692 t/a			High-solvent content => High solid coatings
DIY regulated b)	692 t/a	50%	346 t/a			High-solvent content => High solid coatings
DIY non-regulated	692 t/a	50%	346 t/a			High-solvent content => High solid coatings
Total VOC amount	4059 t/a		2029 t/a			
2. Reduction potential						
		Assumed reduction				
B. Small yacht builders b)	1291 t/a	80%	1033 t/a			High-solvent content => Water-based coatings
C. DIY regulated a)	1384 t/a	80%	1107 t/a			High-solvent content => Water-based coatings
DIY regulated b)	692 t/a	80%	553 t/a			High-solvent content => Water-based coatings
DIY non-regulated	692 t/a	80%	553 t/a			High-solvent content => Water-based coatings
Total VOC amount	4059 t/a		3247 t/a			
=> Reduction potential is small => no further assessment done						

19.3. Conclusion of the assessment

VOC emissions of the unregulated marine and yacht coating (including do-it-yourself sector) are about 4 kt per year in EU-27. The maximum theoretical VOC reduction, assuming 50 – 80 %, would result in a VOC emission reduction of 2 – 3.2 kt.

Based on the low VOC emissions of 4 kt per year, on the high costs for product development in a small volume sector and considering the small theoretical VOC reduction potential, it is not proposed to include marine and yacht coatings into the scope of Directive 2004/42/EC.

20. Potential scope extension covering road markings (Option 16)

20.1. Description of the option

Option 16: First assessments have indicated that alternatives to solvent-based road marking products are available. The project team has further assessed the VOC reduction potential of the sector.

Due to the lack of a European association of road marking manufacturers, the project team was confronted with difficulties to obtain an overview on the product group during the first project phase. CEPE does not have a sector group of road marking manufacturers. Therefore it was not possible to obtain on time sufficient knowledge about the product group to develop a proposal for further impact assessment.

In agreement with the Commission, in the second project phase the project team has undertaken an indepth research on the product group. In some Member States, e.g. in Germany, road markings for public tenders have to be approved by the national road administration, and related lists of approved manufacturers have been made available on the internet.

Based on consultations of national road marking administrations and on interviews with manufacturers a report on road marking systems was compiled, including requirements on road markings, information on solvent content and VOC emissions, on different types of applications and on VOC reduction options (see annex 17 on page 235).

20.2. Summary of the assessment

20.2.1. Road marking systems and related VOC emissions

Four different road marking coating systems are used in Europe, showing different characteristics of VOC emissions according to the coating system used and (in case of foil system) depending on the application technique.

Table 50: Solvent content and related VOC emissions of road marking systems

Paint Systems		Cold plastic Systems	Thermoplastic Systems	Foil Systems
solvent-based	water-based			
medium to high solvent content	low solvent content	medium solvent content (reacting during polymerisation)	no solvent content	in foils: no solvent content. Solvents contained in primers.
medium to high VOC emission	low VOC emission	low VOC emissions	no VOC emission	VOC emission if applied with primers

According to statistics of Dow Chemical, in 2002 about 90,000 tons of road marking paints were applied in EU15 (table except Ireland), whereof 80% was solvent-based (about 72,000 tons, see Table 51).

Table 51: Road marking sales [tons/year] in 2002 in EU 15 (except Ireland)

Countries	Solvent based paints	Water based paints	Thermo-plastics	Cold plastics	Total
Austria	3'500	700	1'000	500	**5'700**
Belgium	5'000	150	1'200	500	**6'850**
Denmark	400	200	6'200	100	**6'900**
Finland	300	2'000	4'000	100	**6'400**
France	18'000	4'000	8'000	3'000	**33'000**
Germany	14'000	2'800	12'000	8'000	**36'800**
Holland	4'000	200	6'000	500	**10'700**
Italy/Greece	19'000	1'000	5'000	1'000	**26'000**
Luxembourg	600	-	-	100	**700**
Spain/Portugal	7'600	2'400	6'000	1'000	**17'000**
Sweden	70	900	12'000	300	**13'270**
UK	500	100	35'000	1'000	**36'600**
Total	**72'970**	**14'450**	**96'400**	**16'100**	**199'920**

[Position Paper Manufactuerer, 2009]

Assuming an average solvent content of 25 %, solvent-based systems lead to 18,000 tons of VOC emission in EU-15 (except Ireland).

The table does not show VOC emissions from foil road marking systems. For temporary application in Germany these have been estimated with 144 – 160 t of VOC emission per year, based on an average solvent content of 80 % in the primers. Foils for durable application use different primers with a VOC content of about 40 %, resulting in about 16 – 21 t of VOC emission per year. For comparison, VOC emissions from solvent-based paint systems are about 3,500 t/a.

If the total amount of solvent-based paints would be substituted by water-based paints, the solvent consumption of 18,000 t would be reduced to 1,400 - 3,600 t. This would lead to a VOC emission reduction of 14.4 to 16.6 ktons (-86%).[52]

[52] According to producers of water-based coatings, the assumption of an average solvent content of 25% for solvent-based systems is regarded as a conservative approach. The VOC emission reduction potential is estimated with 20 kt [Dow Chemical, 2009].

20.2.2. Common road marking systems

In Europe, commonly used systems for road marking vary significantly.

In Sweden, most of the *original* road marking is done with thermoplastics; the remaining proportion is usually done with dispersion paints. [Sweden, 2009] In Germany, original road marking is normally done with cold plastics or thermoplastics, especially on federal roads. [BASt, 2009] [Sikkens, 2009]

Repair coating can be done with re-painting on top of the existing systems. Painting over is typical e.g. in the Netherlands, Germany and Sweden. In Germany, about 85 % of paint road marking systems are used for re-painting. [DSGS, 2009]

For *temporary* road marking, in Germany normally foils are used, even if relative expensive and working-intensive. [Regierungsbezirk Karlsruhe, 2009]

20.2.3. National VOC limit values for road marking systems

In several European countries restrictions for VOC solvent content in paint road marking systems are implemented, which are brought to bear on public tenders.

In Germany, for public tenders the solvent content of paint road marking systems (i.e. solvent-based or water-based) must not exceed 25w-% ("minimum 75w-% solid content"). [ZTV M 02].

Austria as well restricts the solvent content of solvent-based paints in public tenders to 25w-% ("> 75w-% solid content"). [ÖNORM B 2440]

In the Netherlands, a regulation for public tenders will come into effect soon, limiting the VOC-content to 28w-%. [BRL 9141/03] [Veluvine, 2009]

In Sweden, since 1986 the solvent content of road marking systems is restricted in public tenders to 2w-% by the Swedish Road Marking Administration (Vägverket), which practically means a ban of solvent-based paint systems. [ATB Väg 2005]

Also in Finland a factual ban of solvent-based paint road marking systems is in force since 2007 by enforcement of a VOC limit of 2w-%. [Policies for Road Markings, year 2006]

VOC limits for paint road marking system can also be found in non-European countries. The Environment Protection Agency in the USA set a VOC limit of 100 g/l in 1998, equivalent to about 5w-%. In Canada a restriction to 5w-% was implemented in 2005. [Position Paper Manufacturers, 2009]

If the total amount of solvent-based paints would be substituted by water-based paints, the solvent consumption of 18,000 t would be reduced to 1,400 - 3,600 t. This would lead to a VOC emission reduction of 14.4 to 16.6 ktons (-86%).[53]

20.2.4. Substitution of paint road marking systems

Regarding *repair coating* with water-based paint systems, some producers argued that bonding of paints would need solvents to etch the former marking and to deal with soiled and oily surfaces. Other producers argued, that the etching effect of solvents is not necessary, stressing that the argument is technically outdated. Depending on the formula of the water-based paints, dispersions as well adhere on dirty surfaces and are well able to be used for re-painting. Dispersions would even be used to act as adhesion promotion primers. [Position Paper Manufacturers, 2009] [Cleanosol, 2009]

Original coating with solvent-based paints can be substituted with water-based paints or with thermoplastic or cold plastic systems.

The consultation revealed that in Sweden, Norway, Finland, Island and in all different climatic zones in the USA, water-based paint systems are commonly used for original road marking, bring up good results. This means that water-based paint systems are used under cold and humid weather conditions as well as in warm or hot climate. The lowest temperature recommend for the application of water-based paints is about 5°C (solvent-based paints are usually not applied at temperatures < 5°C as well). The wash-out time of the water-based systems would not be significantly higher than the wash-out time of solvent-based paints, depending on the formula and the handling of the water-based systems. [Position Paper Manufacturers, 2009] [Cleanosol, 2009]

20.3. Conclusions of the assessment

Several countries in Europe and North America have implemented VOC limit values for road marking systems. These limits partly require the use of high-solid systems, partly require complete substitution of solvent-based paint systems because the VOC limits can only be achieved by water-based paint systems, thermoplastic or cold plastic systems.

It is proposed to undertake an impact assessment on the following option:

Inclusion of road markings in the scope of Directive 2004/42/EC by setting a limit value of 60 g/l. (Complete substitution of solvent-based paint systems).

This proposal is supported by a group of manufacturers [Position Paper Manufacturers, 2009].

[53] According to producers of water-based coatings, the assumption of an average solvent content of 25% for solvent-based systems is regarded as a conservative approach. The VOC emission reduction potential is estimated with 20 kt [Dow Chemical, 2009].

21. Potential scope extension covering water-repellent impregnation products (Option 17)

21.1. Description of the option

Water-repellent impregnation products use solvents and therefore have been identified as potential subject for extension of the scope. During the first project phase, little information had been obtained about this product group.

In accordance with the Commission, the project team has undertaken further assess of the VOC reduction potential in the sector with the aim of proposing an option for future impact assessment or considering the product group not appropriate for inclusion into Directive 2004/42/EC.

21.2. Description of the product group

Water repellent impregnation products are applied to the exterior walls of buildings as well as to constructions such as bridges in order to make them water-repellent. An extensive document, describing markets and technical requirements was submitted by the Centre Européen des Silicones of CEFIC ([CES, 2009], see annex 46). Generally, the products are applied to "stoney" substrates such as concrete, natural stone, limestone, brickwork and sand-lime brick [CES, 2009].

Water-repellent impregnation products prevent the entrance of water to the construction, without hampering the passage of water-*vapour*. The latter property is important because it enables the removal of excess humidity from a building (´breathability´). Protection of historical heritage such as historical buildings and statues is one of the major markets for water repellent impregnation products [CES, 2009].

The major active constituent of the products are silanes and siloxanes, which polymerize to a water-repellent resin after application. Generally, the products are diluted with solvents and/or water on-site. At the polymerization reaction, volatile alcohols (methanol, ethanol) are split-off and released.

According to industry information, there is a large variety of product types, each having its own specific area of application, depending on e.g. the porosity and pH-value of substrate and on climatic conditions.

Types distinguished include [CES, 2009]:

- Alkali siliconates, water-based (WB);
- Silicone resins, solvent-based;
- Alkoxysilanes, neat (non diluted);
- Alkoxysilane/ alkoxysiloxane emulsions, WB;
- Alkoxysilane/alkoxysiloxane pastes and creams (WB).

21.3. VOC emissions due to the use of water-repellent impregnation products

CEFIC was contacted to support data collection on waterproofing and impregnation products with the following questions:

- The total volume of waterproofing and impregnation products sold by CES members in the EU 27 (tonnes in 2007)
- The total volume of solvents contained in these products (tonnes)
- Exemplary solvent content of most commont products (range in %)

Results expressing total consumption and total VOC-emission have been obtained from an industry survey by CEFIC-CES, see Table 52. The data comprise VOC emissions of about **12 kt** related to the use of water-repellent impregnation products in EU-27 in 2007 [CES, 2008]. Underlying databases, demonstrating e.g. the relative market sizes in the member states are not available.

Table 52 demonstrates that the products as sold are concentrates, containing little solvent (2nd column). The solvent-based products are diluted with solvents on-site (5th column). The amount of VOC (methanol or ethanol, split-off and released from the "monomer" silanes and siloxanes) is shown in columns 3 and 4 of Table 52.

It has to be realised that part of the active ingredients (volatile siloxane monomers) are VOC as well, considering their boiling point (below 250 °C). However, according to article 2 (6) of the Directvie, these reactive ingredients are not regarded as part of the VOC content as they become part of the cured resin.

Table 52: Total volume of waterproofing products sold in 2007 in EU-27 and related VOC emissions (CES survey)

Total amount of products [t/a]	Solvent contained [t/a]	Solvent released (Methanol) [t/a]	Solvent released (Ethanol) [t/a]	Solvent Added [t/a]	Total VOC emission [t/a]
2995	120	214	524	11 083	11 821

[CES, 2008]

21.4. VOC-reduction options and reduction potential

Manufacturer's information has revealed that – in addition to several types of active ingredients – both high and low VOC product types with largely varying VOC-content are on the market already [CES, 2009]:

Table 53: Product types of water-repellant impregnation products and

Product type	Typical VOC-content* (CES, 2009)
Solvent based	90-98%
Cream based	60%
Water based	20%
Water based creams for highly alkaline mineral Substrates (concrete)	10%
Alkoxysilane (neat;i.e. non diluted)	5%
Water based alkali siliconates for neutral mineral substrates	0%
* Without the volatile active ingredient and the alcohols that split off	

[CES, 2009]

Information from one individual supplier indicated lower VOC-contents for cream based products of about 40%. The 0% water-based products would have a limited applicability [CES, 2009].

Initial discussions with industry, as well as the document provided by the manufacturers [CES, 2009] revealed that the low(er) VOC water-based or cream based versions cannot be used for all applications.

Industry was able to provide only a rough estimate of the current relative market shares of the various types in three categories:

- Water-based (all types) 65%
- Solvent based 25%
- Cream based 10%

These figures seem to indicate that low(er) VOC products have gained a significant market share already. According to industry, regional differences across the EU may be significant, “due to country to country variability in construction materials” (CES, 2009). As a result, the markets in Southern Europe would consume more solvent-based products (55-60%) because of the impregnation of (dense) limestone. On the other hand, on markets in Northern Europe in which brick is prevalent, water-based products are more predominant (45-50%). Water based products perform best on relatively porous substrates such as brick. Generally, cream based products are more widely applicable than water-based products.

VOC reduction by *shifting* from solvent-based to cream based or water-based has been going on by means of autonomous developments over the last 10 years mainly, since water-based product came to the market [CES, 2009]. It is stated that water-based products are currently first choice, wherever possible. However, it is believed by industry that solvent-based products will remain to be needed for specific, demanding applications, such as dense materials in which water-based products cannot easily penetrate.

With regard to VOC reduction *within* the various product types, CES states that (for various technical) reasons, further reductions in the *various* products is currently not feasibly (see annex XX). The values stated in the table above – current state of the art - are regarded as the limit values currently achievable.

21.5. Conclusions of the assessment

For the above mentioned reasons of a relatively low product consumption combined with a low or absent additional VOC-reduction potential it is advised not to consider the product group of water-repellent impregnation products for inclusion in Directive 2004/42/EC.

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Annexes

Annex 1:

1. Decorative coatings – Experiences with category definitions and VOC limits

The project team has gathered information on implementation problems resulting from the category definitions for decorative paints. Moreover, the appropriateness of current VOC limits was studied.

For this purpose, the project team has consulted all 27 EU Member States as well as stakeholders on the question whether the definitions of annex I of Directive 2004/42/EC are 'fit for purpose' (chapter 1.1).

The consultation of Member States was carried out with a questionnaire, supported by the first regular Member States report on Directive 2004/42/EC, delivered to the Commission in summer 2008. The consultation of stakeholders was done on meetings with technical sector experts, mainly organised by CEPE and UNIEP, supplemented with follow-up position papers (see annexes 30 and 31).

Furthermore, stakeholders (CEPE and UNIEP) have been asked to report on problems identified with the existing 2007-limits or expected for the prescribed 2010-limits for decorative coatings. Results can be found in chapter 1.2.

Member States have been asked whether stricter VOC limits for decorative coatings are applied on a national level. Answers are summarized in chapter 1.3. Information on the existing Dutch regulation is presented in chapter 1.4.

1.1. Problems related to existing category definitions for decorative coatings

As products under the current scope of Directive 2004/42/EC cover a wide range of applications, precise product categories are needed to enable an unambiguous classification of each product.

1.1.1. Member States on difficulties with existing categories

Four Member States have reported that allocation of products into existing categories was one of the main difficulties when implementing Directive 2004/42/EC (AT, DE, EL, PT).

Germany and Portugal refer in general to the classification of products into the existing categories and definitions. [DE Report 2008] [PT Report, 2008] Austria and Greece reported allocation difficulties if products meet the criteria of more than one subcategory. [AT Report 2008] [EL Report, 2008]

Denmark reported that it is difficult to decide, whether a woodstain is falling under the scope "because it is depending on the thickness of the layer and film" [DK Quest, 2008]. Denmark also reported the problem that products might have more than one attribute, making unclear to which category a product belongs to.

Austria reports various overlaps of the definitions of the categories. 'These were usually borderline cases which met criteria of both categories […], either in part or in full.' Nevertheless, the overlap was not a problem of compliance: 'In none of these cases the limit values were exceeded, not even where the lower limit value was applied if the limit values of the subcategories in question differed.' [AT Report, 2008]

Table 54 shows examples of difficulties in Austria when allocating products.

Table 54: Difficulties of product allocation into product groups reported by Austria

Product	Categories affected	National solution
Uncertainty, in particular in the case of woodstains	A (e) interior/exterior trim varnishes and woodstains A (f) minimal build woodstains	Agreement about classification
Varnishes for parquet flooring	A (i) one-pack performance coatings (e.g. floor coatings) A (e) interior/exterior trim varnishes and woodstains	Both classifications accepted
Decorative effect coatings	A (l) decorative effect coatings A (a) matt coatings for interior walls and ceilings	Both classifications accepted

[AT Report, 2008].

In case of the woodstains, authorities and companies in Austria agreed on the product category classification. In case of the varnishes for parquet flooring as well as for decorative effect coatings, authorities accepted any of the two possible classifications, as the VOC content in no case exceeded the VOC limit of the category with the lower limit. [AT Pers, 2008]

In case of decorative effect coatings "the products were usually classified as category A (a), as in all cases these were dispersion-based products." [AT Report, 2008]

1.1.2. Member States proposals for changing current definitions

The Member States have been asked: "Do you have proposals for change of category definitions?"

Answers were given by 22 Member States. 12 Member States (AT, BE, CZ, DK, EL, FI, IE, LT, MT, RO, SE, UK) made proposals and 10 Member States (BG, CY, EE, ES, HU, LV, NL, PL, SI, SK) did not propose a change of category definitions.

Table 55 gives an overview on the answers, focussing on answers related to decorative paints.

Table 55: Proposals by Member States

Defining product by type of surface to be coated	BE, CZ
Unite categories with overlapping scope and same limit values	DK
Categories should reflect those used by industry	MT
Devision of catgory A/d, A/e and A/f into interior and exterior application	SE
Change definition of category A/i	RO
Change definition of category A/l	RO, AT
No proposals	AT, BG, CY, EE, ES, HU, LV, NL, PL, SI, SK

1.1.2.1. General proposals

Currently, in category A in annex II of Directive 2004/42/EC the categorisation of products depends on the object that is coated. The object has to belong to a 'building' or parts of it. Belgium and the Czech Republic propose "a broader definition" [CZ Quest, 2008]. The products should be defined by "type of surface and effect on the surface" [BE Quest, 2008], which means, products should be dedicated for the use on metal, glass or wood, "and regardless of whether we use it on the buildings, windows, furniture, etc" [CZ Quest, 2008].

Denmark in general proposes to "to reduce the number of categories, and make the definitions more widely, especial where the limit value is the same." [DK Quest, 2008]

Malta states, that "the categories should reflect those used by industry."
[MT Quest, 2008]

1.1.2.2. Category specific proposals

Proposals on categories A/d, A/e and A/f

Sweden proposes to divide subcategory A/d into:
* d_I for Interior trim and cladding paint for wood, metal or plastic substrates
* d_{II} for Exterior trim and cladding paint for wood, metal or plastic substrates
and to consider this subcategories also for A/e and A/f. [SE Quest, 2008]

Proposals on category A/i

Romania suggests defining category A/i more precisely. Romania proposes "to replace *'They are designed for applications requiring a special performance, such as primer and topcoats for plastics…' with: 'They are designed for applications requiring a special performance, such as primer and topcoats for plastics and **metals**'* "[RO Quest, 2008].

Proposals on category A/l

Romania further more proposes for category A/l to "include in the following text: *'decorative effect coatings - coatings designed to give special aesthetic effects over specially prepared pre-painted substrates or base coats and subsequently* *treated with various tools during the drying period* ***or untreated'*** [RO Quest, 2008].

Austria states, that an "overlapping of fields of application was to be observed in the case of decorative effect coatings (category A/l). In this case the products were usually classified as category A/a, as in all cases these were dispersion-based products. Even where the category A/a limit value was applied, no cases of non-compliance were found" [AT Report, 2008]. Therefore, Austria "suggests thinking about integration of category A/l into category A/a" [AT Pers, 2008]

1.1.3. CEPE proposal to change existing categories for decorative paints

CEPE states: 'To prevent (further) confusion, and not to frustrate accomplishments made so far, it is not advisable to propose major changes in subcategories. However, small changes of some definitions are needed for clarification.'

Table 56 shows the changes proposed by CEPE and their justification regarding the categories of annex I (1) of Directive 2004/42/EC comprising paints and varnishes (see complete CEPE position in annex 2).

Table 56: CEPE proposal to change existing categories for paints and varnishes

Current wording of annex I (1)	CEPE proposal	CEPE justification
d) "interior/exterior trim and cladding paints for wood, metal or plastic" means coatings designed for application to trim and cladding which produce an opaque film. These coatings are designed for either a wood, metal or a plastic substrate. [etc.]	d) "interior/exterior trim and cladding paints for wood" means coatings designed for application to trim and cladding which produce an opaque film. These coatings are primarily designed for a wood substrate. [etc.]	d) Simplification. Volumes applied on metal and plastic are negligible.
e) "interior/exterior trim varnishes and woodstains" means coatings designed for application to trim which produce a transparent or semi-transparent film for decoration and protection of wood, metal and plastics. [etc.]	e) "interior/exterior trim varnishes and woodstains" means coatings designed for application to trim which produce a transparent or semi-transparent film for decoration and protection of wood. [etc]	e) Simplification. Volumes applied on metal and plastic are negligible.
i) "one-pack performance coatings" means performance coatings based on film-forming material. They are designed for applications requiring a special performance, such as primer and topcoats for plastics, primer coat for ferrous substrates, primer coat for reactive metals such as zinc and aluminium, anticorrosion finishes, floor coatings [etc.]	i) "one-pack performance coatings" means performance coatings based on film-forming material. They are designed for applications requiring a special performance, such as primer and topcoats for plastics and metals, floor coatings [etc.]	i. Simplification

[CEPE, 2008c]

The CEPE proposal for changes in categories (d) and (e) would exclude interior and exterior trim and cladding paints as well as trim varnishes for metal and plastic substrates from the scope of Directive 2004/42/EC. However, metal constructions and fixed items can be considerable parts of a building.

The project team considers the classification of coatings for metal or plastic substrates as unambiguous. Allocation problems have not been reported.

Therefore the proposal represents an unnecessary reduction of the scope of the directive, even if CEPE considers the volumes as 'negligible'. It was agreed with the Commission not to assess further the proposed exclusion of the product groups from the scope of the directive.

1.2. Stakeholder comments on current VOC limits for decorative coatings

1.2.1. Consultation of paint manufacturers (CEPE)

Major problems with the current VOC limits have not been reported by CEPE.

However, statements from CEPE have been received on the lacking potential for further reductions – indicating some challenges of the current VOC limits of 2007 and 2010 (see CEPE position paper in Annex 30 'Rationale for no further reductions beyond the 2010 VOC limits', 22.08.2008)

Table 57 shows CEPE statements on the 2010-limits of categories d) and e) for decorative coatings and evaluations of these comments by the project team (see complete CEPE statements on Directive 2004/42/EC in Annex 27). The other categories will not bring about relevant challenges in 2010.

Table 57: Evaluation of CEPE comments on 2010-VOC limits for decorative coatings

Category	Limit	CEPE statement (see annex 3)	Evaluation by consultants
d) Interior/ exterior trim and cladding paints for wood, metal or plastic	WB 130 g/l	Extremely demanding limit. Workable products with excellent gloss and flow are not yet widely commercial or accepted by skilled professional painters.	The limit for interior application by professional painters in the Netherlands is 100 g/l
	SB 300 g/l	Extremely demanding limit. Workable products with excellent gloss and flow are not yet widely commercial or accepted by skilled professional painters.	Probably close to lowest achievable limit indeed, because exterior application has to be covered in various climatic circumstances.
e) Interior/ exterior trim varnishes and woodstains	WB 130 g/l	Extremely demanding limit, if products with excellent penetration and showing natural appearance of wood have to be formulated.	The limit for interior application by professional painters in the Netherlands is 100 g/l
	SB 400 g/l	Extremely demanding limit, if products with excellent penetration and showing natural appearance of wood have to be formulated.	
WB: water-based, SB: solvent-based			

The industry statement that certain products with a low VOC are not yet 'widely commercial' refers to various issues:

- technically: ease of application, reliability of the performance under a variety of circumstances (by industry often referred to with the term 'robustness');
- market: it is generally preferred to have (much) more than one supplier of innovative products, in order to have competition;
- end user preferences: acceptance of the new product types if they have altered properties; ability to cope with altered properties.

For paints and vanishes (annex II B of Directive 2004/42/EC) it is supposed by the consultants that the limits are close to the lowest achievable limit, in particular the 2010-limit of 300 g/l for category (d). This evaluation recognises the fact that the category comprises a wide range of solvent-based products, including products for outdoor applications that have to be fit-for-purpose in various climates.

However, the Dutch association of paint manufacturers (VVVF) and large paint manufacturers have reassured professional end users that the 2010-limit of 300 g/l limit is no problem, and that quality standards are achieved [Eisma's Schildersblad, 2007].

1.2.2. Consultation of painters (UNIEP)

The International Association of Painting Contractors (UNIEP) has made a consultation of its member companies to obtain end users' opinions on feasibility of

2007-VOC limits for paints and varnishes (products of annex II A of Directive 2004/42/EC).

Answers on the query were obtained from 12 UNIEP members, representing different sizes of organisations, form less than 60 employees (ES-1, ES-2, LU) or less than 5000 employees (AT, FI, HU, IT, NO) up to major associations representing 8000 to 200,000 employees (DE, DK, UK, NL).

With the inquiry, the following results were obtained [UNIEP, 2008]:

1. In all countries but LU more than 50 % of indoor paints are water-based.

2. Less than 50 % water-based outdoor paints are used in NL, IT, LU, ES-1, NO, all others use more than 50 % water-based outdoor paints.

3. Experience with water-based VOC-reduced paints is predominatly positive, with the exception of AT and IT.

4. Positive experience with high-solid solvent-based paints was made in all countries except from DE.

5. When using VOC-reduced paints, most users have made negative experience at temperatures below 8°C, except FI and UK.

6. Negative effects of VOC-reduced paints on winter employment were made only made in AT, DE and DK, but not in all other countries.

7. Only Germany reported negative effects also on summer employment.

8. Positive effects of VOC-reduced water-based or solvent-based paints on workers' health were acknowledged by all countries except AT and DE.

9. Problems with guarantees when using VOC-reduced solvent-based paints were only reported from HU; guarantee problems using VOC-reduced water-based paints were reported from only from AT and ES-1.

10. A 'remarkable' price increase was reported for water-based VOC-reduced paints from 50 % of the countries, same as for VOC-reduced solvent-based paints. No price increase was noted in AT, LU, NL, UK.

11. 50 % of all answers stated that painters are not aware of 2010-limits.

12. In the majority of participating countries training is done on the use of VOC-reduced new painting material, e.g. by national training bodies.

13. Regarding re-use, disposal or cleaning of brushes, the majority answered that brushes are cleaned with solvents, except DE, FI, HU. No cleaning is done by DE and HU. All painters apply overnight-storage for re-use of brushes when using solvent-based paints. All except IT use overnight storage of brushes also for water-based paints. Specific settling agents are known and used in 50 % of the answering countries.

1.3. Member States on stricter VOC limit values for decorative coatings

1.3.1. General Member States feedback on existance of stricter national VOC limit values for decorative coatings

Member States have been asked: “Do additional/stricter national VOC limits on Decopaint products exist in your country?”

Answers were given by 22 Member States. All 22 Member States stated, that in general no stricter national VOC limit values are applied for products currently under the scope of Directive 2004/42/EC (answers from AT, BE, BG, CY, CZ, DK, EE, EL, ES, FI, HU, IE, LT, LV, MT, NL, PL, RO, SE, SI, SK, UK).

Nevertheless, The Netherlands and Sweden reported imposing stricter VOC limits for certain work environment.

Sweden “has provisions on work environment that have impact on the indoor paints. The Swedish Work Environment Agency regulation ASF 2005:17 on work limit-values and measures against air pollutants requires in art. 5 that '*on an occasional work place, indoors and in an closed-in space (no ventilation) products containing no organic solvents or water-based products shall be used, if not other products are required for technical or cultural historical reasons'*” [SE Quest, 2008].

The proposal of Sweden takes up a proposal which has already been made in 2000 in the inquiry for the EC-2000 study [Van Broekhuizen et al., 2000], before Directive 2004/42/EC was adopted. The proposal comprised the introduction of a distinction between 'indoor' and 'outdoor' in decorative coatings categories (d) and (e). Establishing this distinction would allow setting stricter limits for indoor paint products. At the time of the EC-2000 study, this option was proposed as in a few Member States this distinction was already current practice (Denmark, Sweden) or incorporated in national regulations (Netherlands).

In the case of the Netherlands, an occupational health related regulation has set VOC limits for indoor paints to be complied with by professional painters:

- wall paints (all types): 60 g/l.
- all other paints: 100 g/l.

In practice, these limits mean that either water-based or solvent-free products have to be used, as solvent-based technologies complying with such low VOC limits are not available. For details of the regulation see chapter 1.4.

1.3.2. Member States proposals for VOC limit reduction

Two Member States (DK, SE) proposed the reduction of VOC limit values for products covered by the scope of Directive 2004/42/EC.

Sweden proposes to divide subcategory A/d into:

* d_I for *Interior* trim and cladding paint for wood, metal or plastic substrates
* d_{II} for *Exterior* trim and cladding paint for wood, metal or plastic substrates

and to consider the same subcategories for A/e and A/f [SE Quest, 2008].

Table 58: Swedish proposal for new product sub-categories

ANNEX II A, Product Subcategory d	Swedish proposal ANNEX II A, Product Subcategory d
d) Interior/exterior trim and cladding paints for wood, metal or plastic substrate Phase I (g/l) – Phase II (g/l) WB 150 – 130 SB 400 – 300	d_I) Interior trim and cladding paints for wood, metal or plastic substrates Phase I (g/l) – Phase II (g/)l WB 150 – 130 SB 300 – 250/NLA* d_{II}) Exterior trim and cladding paints for wood, metal or plastic substrates Phase I (g/l) – Phase II (g/l) WB 150 – 130 SB 400 – 300
* NLA: no longer allowed	

[SE Quest, 2008]

Sweden argues that these paints have a high share of all decorative paints according to Van Broekhuizen [2000], are mainly based on petroleum solvents (white spirits) having the highest ozone generating potential, and reduction would reduce human exporure to harmful substances [SE Quest, 2007].

Table 59 shows the additional VOC reduction potential that would arise from this proposal according to estimations made in 2000 for EU-15 and for EU-15 plus 6 'accession countries', assuming that interior applications account for 75 % of the trim paint consumption [Van Broekhuizen et al., 2000].

Table 59: VOC reduction potential estimated in 2000 for EU-15 and for EU 15 plus 6 major 'accession countries' when applying separate VOC limits for indoor and exterior paints of categories (d) and (e)

Scope	VOC emissions with VOC limits as set by Directive 2004/42/EC	VOC emissions with separate VOC limits for indoor and exterior paints	Additional reduction
EU-15	237 kt/y	215 kt/y	22 kt/y
EU-21*	273 kt/y	248 kt/y	25 kt/y
* EU-15 and Czech Republic, Poland, Hungary, Slovenia, Slovakia, Turkey			

[Van Broekhuizen et al., 2000, p. 199f]

The additional VOC reduction potential seems to be considerable. However, the benefit of such a distinction between ‘indoor’ and ‘outdoor’ painting is not guaranteed, because labelling on the package like ‘Only for outdoor use’ does not prevent from indoor use.

The VOC reduction potential resulting from the Swedish proposal is difficult to estimate. No exact data on the relative share of interior and exterior paint consumption are available. Due to differences of national habits and building materials this will vary considerably from country to country. For example, in a number of countries it is common practice to paint exterior wooden house facades (Scandinavia), while in most other countries wooden facades are rare.

A first estimation by extrapolation of estimates for EU-15 (22 kt), assuming 75 % interior use [EC, 2000] with the EU-27/EU-15 inhabitant factor for 2006 (493/390) [EUROSTAT, 2008], the **reduction potential** of the Swedish proposal would be about **27.800 tonnes of VOC**.

1.4. Dutch regulation on interior use of paints

Information has been gathered on a regulation introduced by the Dutch government limiting the VOC content of *interior* decorative paints. This regulation has come into force on 1.1.2000. It resembles the Swedish proposal, but there are significant differences.

1. Dutch regulation has defined just two general category limits:

I. All (interior) <u>wall</u> paints: 60 g/l
This includes both category a) and b) of Directive 2004/42/EC.

II. <u>All other</u> (interior) paints: 100 g/l
This includes all other categories d) to j) of Directive 2004/42/EC

The limit of the first Dutch category is slightly higher than the one of the related category a) of Directive 2004/42/EC for matt wall paints (30 g/l) and lower than the limit for category b) of Directive 2004/42/EC for glossy wall paints (100 g/l).

Current 2010-limits of Directive 2004/42/EC for these two categories range from 30 to 200 g/l for water-based products, and from 200 to 750 g/l for the solvent-based products. In practice, hence, the Dutch regulation prevents the use of solvent-based products for indoor use.

2. The <u>use</u> of non-compliant paints is regulated instead of ‘<u>placing</u> the products on the market’

The Dutch regulation does not ban solvent-based products from the market, i.e., it’s not a product-regulation. Instead, it bans the use of high-VOC products in certain applications: interior and <u>professional</u> painters only.

Therefore, the regulation is not enforced by the environmental inspection, customs etc., but by the Labour Inspectorate. The Labour Inspectorate checks the use of compliant products on-site at ‘painting projects’ (i.e. newly constructed buildings or maintenance). No check of compliance will be done by inspecting e.g. paint stocks at painting contracting companies, because the high-VOC paints are allowed for exterior use.

The Labour Inspectorate checks compliance in two ways:

- once in 2-3 years organising an inspection campaign, visiting a large number of sites (300-400);
- carrying-out ‘ad-hoc’ inspections after (e.g.) complaints from workers being forced by employers to use high-VOC paints.

3. Only professional painters have to comply

The aim of the regulation is preventing the occupational disease ‘Chronic Toxic Encephalopathy’ due to the frequent and long-lasting exposure to solvent-vapours among professional painters.

Therefore, the regulation focuses on professional use only, as consumers tend to use paints only occasionally. In the Netherlands, the relative consumption of Directive 2004/42/EC relevant paints by professionals and consumers is roughly 46 % and 54 %, respectively, being about half of the - interior painting - market regulated by the regulation in place.

4. VOC definition differs

The VOC definition used in the Dutch regulation is not similar to the definition used in Directive 2004/42/EC:

- Dutch regulation uses the definition of Directive 1999/13/EC: vapour pressure > 0.01 kPa at 293 K.

Depending on the specific type of solvent, certain solvents may be counted in Directive 2004/42/EC which do not count in the Dutch regulations.

However, the definition will not affect the switch from solvent-based to water-based paints resulting from the regulation, but only cause slight differences in the VOC-limits *within* the category of (mainly) water-based paints.

5. Exemptions only with a license

The Dutch regulation exempts a few specific applications from the VOC-limits:

- restoration of ancient buildings;
- damage repair to steel constructions formerly painted with high-VOC paints;
- isolation (‘blocking’) of stains caused by fires (soot).

However, these are no general exemptions, but painting contractors have to apply for the exemption at the Labour Inspectorate, on a case-by-case basis.

Annex 2:

2. Vehicle refinishing coatings – Experiences with category definitions and VOC limits

2.1. Introduction

The project team has collected information to identify problems with current category definitions for vehicle refinishing products and to assess the appropriateness of VOC limits.

For this purpose, the project team has consulted Member States and stakeholders on the question whether definitions of annex I of Directive 2004/42/EC are ‘fit for purpose’ (see chapter 2.2).

The consultation of Member States was done via a questionnaire, supported by answers given in the regular reports on Directive 2004/42/EC, delivered by the Member States to the Commission in summer 2008. The consultation of stakeholders was done during meetings with technical sector experts organised by CEPE, supported by follow-up position papers of CEPE.

Member States have been asked whether stricter limits are implemented on a national level. Answers are summarized in chapter 2.3.

Furthermore, stakeholders (CEPE, AIRC and CECRA) have been consulted to evaluate whether problems have been identified with the existing VOC limits and whether stricter limits are feasible.[54] Results can be found in chapter 2.4.

2.2. Problems related to current category definitions for vehicle refinishing products

The project team has consulted Member States and stakeholders on the question whether definitions of annex I of Directive 2004/42/EC are ‘fit for purpose’.

2.2.1. Member States on difficulties with existing categories

Four Member States have reported that allocation of products into existing categories was one of the main difficulties when implementing Directive 2004/42/EC (AT, DE, EL, PT). Germany and Portugal refer to the classification of products into the existing categories and definitions in general. [PT Report, 2008] [DE Report 2008] Austria and Greece have reported allocation difficulties, if products meet the criteria of more than one subcategory. Austria reports various overlaps of the definitions of the categories. [AT Report, 2008]

Greece mentions difficulties to differentiate between the ‘subcategories (d) and (e) of annex II, 2’, comprising the categories (d) for ‘topcoats’ and (e) for ‘special finishes’. [EL Report, 2008]

[54] The wish for a feasibility assessment regarding stricter VOC limits for vehicle refinishing products is verbalised in Article 9 (b) of Directive 2004/42/EC, inviting the Commission to submit to the European Parliament and the Council a report examining among others ‘the possible introduction of a further (phase II) reduction in the VOC content of vehicle refinishing products’.

2.2.2. Member States proposals for changing current definitions

The Member States have been asked: “Do you have proposals for change of category definitions?”

Answers were given by 22 Member States. 12 Member States (AT, BE, CZ, DK, EL, FI, IE, LT, MT, RO, SE, UK) made proposals and 10 Member States (BG, CY, EE, ES, HU, LV, NL, PL, SI, SK) did not propose a change of category definitions.

Table 60 gives an overview on the answers, focussing on answers related to vehicle refinishing products.

Table 60: Proposals by Member States

Unite categories with overlapping scope and same limit values	DK
Categories should reflect those used by industry	MT
More thightly definition of category B/e “special finishes”	IE, UK
Avoid overlap of category B/d and B/e	EL, LT
Reassign “aerosols for vehicle preparation” under category B/e	FI
No proposals	AT, BG, CY, EE, ES, HU, LV, NL, PL, SI, SK

2.2.2.1. General proposals

UK suggests the “special finishes category could be more tightly defined.” [UK Quest, 2008] and Malta states, that “the categories should reflect those used by industry.” [MT Quest, 2008]

2.2.2.2. Category specific proposals

Proposals to avoid the overlap of category B/e and B/d

Category B/d covers all kind of 'topcoats', whereas category B/e covers all kind of 'topcoats' which additionally require special properties. Those topcoats with special properties are defined as 'special finishes'. For 'topcoats' of category B/d a maximum VOC content of 420 g/l is allowed, whereas for the 'topcoats' with special properties of category B/e the allowed maximum VOC content of 840 g/l is proportionately doubled.

Lithuania as well as Greece state, that there is an overlap in-between the categories B/e and B/d. Greece state, that “a product of subcategory d could be declared as subcategory e, e.g. by asserting that it has anti-scratch properties” [EL Quest, 2008] and that this “cannot be checked in practice” [EL Quest, 2008]. Lithuania states, that “the producer could shift the product into cat. 2/e by slight modification of content” [LT Quest, 2008] and that “*'special finishes'* could be used as *'topcoat'* vehicle refinishing products” [LT Quest, 2008].Greece and Lithuania propose a revision of this definitions, Greece suggests “to amend this,

[…], the phrase *'anti-scratch and'* has to be removed from the definition of sub-category e” [EL Quest, 2008]

Proposals for better classification of ‘aerosols’ for vehicle refinishing

Finland states, they “have had confusions for example with aerosols for vehicle reparation” [FI Quest, 2008]. These confusions are due to the fact, that aerosols are related to a specific type of application. Thus, products with the purpose of any category of annex II B might also be offered as aerosol and therewith would fall under category B/e instead of the proper category like e.g. category B/d (topcoat). This gives manufactuerer access to a higher allowed maximum VOC content. Finland proposes to better classify 'aerosols'. [FI Quest, 2008] [FI Pers, 2008]

2.3. Member States on stricter VOC limit values for vehicle refinishing products

Denmark states on the limit of 850 g/l VOC for category 2.1 (a) ‘Preparatory products for vehicle refinishing’: “What we experience in practise is that products in this subcategory have a much lower VOC content” [DK Quest, 2008].

Moreover, Sweden asks whether “limit values for vehicle refinishing products will be lowered as well as for paint and varnish until 2010?” [SE Quest, 2008].

2.4. Stakeholder comments on current VOC limits for vehicle refinishing products

2.4.1. Consultation of vehicle repair companies (AIRC)

According to the European association of vehicle repair companies AIRC, the 2007-limits for vehicle refinish coatings have not constituted major technical problems [Horak, 2008]. However, as described in chapter 2.6, major investments have been necessary to comply with the 2007-limits, mainly to improve drying conditions in spray booths. The impact of this has been assessed in the ENTEC/PRA-study commissioned by DG Environment preceding the design of Directive 2004/42/EC [Ritchie, 2000].

AIRC has indicated that vehicle refinish companies have more difficulties than expected to comply with the 2007-limits, mainly because of their weak economic position as described in chapter 2.6. However, quantification of e.g. current margins of profit, necessary investments in spraying booths and higher materials costs is difficult. [Horak, 2008]

2.5. Paint manufacturers (CEPE) on feasibility of stricter VOC limits for vehicle refinishing products

CEPE has submitted a written position on the feasibility of introducing stricter VOC limit values for vehicle refinishing products compared to those defined by Directive 2004/42/EC. The position was elaborated by CEPE's Technical Committee 'Vehicle Refinishing'. [CEPE, 2008c]

As far as the changes have consequences for VOC limits for existing products, they are described in this chapter. The proposed changes of wording (and associated impact on inclusion or exclusion of products) are described in chapters 1.1 and 2.2, referring to problems with existing product categories.

In its rational, CEPE concludes - after having studied further reduction potential - that stricter VOC limits are not be feasible. Current limits would already represent 'demanding targets', and further reductions 'would limit the appearance and performance of the coating', reducing 'both the life and the quality of repaired vehicles, which would be economically unacceptable'. [CEPE, 2008c]

Nevertheless, for '*special finishes'* current having a VOC limit of 840 g/l, CEPE proposes the separation of category (e) into two subcategories, one of them with defined with a stricter VOC limits of 540 g/l comprising:

- Textured finishes, matt finishes, anti slip coatings and
- Reflective basecoats (daylight reflecting coatings used on ambulances, or fire brigade vehicles).

Additionally, CEPE proposes to exclude product groups currently listed in the definition of category (e) 'special finishes', and including them in categories (c) and (d) with stricter limit values:

- 540 g/l (category c) instead of 840 g/l (category e):
  Under-body sealers and anti-chip coatings
- 420 g/l (category d) instead of 840 g/l (category e):
  Metallic or pearl effect in a single layer and high performance solid colour clearcoats (e.g. anti scratch and fluorinated clearcoat).

CEPE argues that for these products a lower VOC content than 840 g/l is state-of-the-art. A shift of the products proposed to be into category (d) would lead to simplification, as they are used as top coats as other products of category (d).

For the other product categories, the following statements have been made:

Preparatory and cleaning (cat. a.): The current VOC limits are 850 g/l for solvent borne and 200 g/l for waterborne. CEPE states that this VOC content is needed to cover difficult cleaning activities when applied, e.g. for removal of grease and for gun cleaning.

Bodyfiller/stopper (cat. b): The current VOC limit is 250 g/l. This product group comprises polyester putties, which use styrene as a reactive solvent. CEPE stated that 'actual VOC emissions will be well below 250 g/l' [CEPE, 2008c].

Primer-surfacer/filler (cat. c, subcategories i and ii): The current VOC limit is 540 g/l. CEPE has reported that there have been various attempts to put 250 g/l in legislation since the early 90's, but that 'no products have made it to the market with success in the last 20 years.' CEPE underlines that 'it is unlikely that this will change in the coming decade too: the most commonly used technology for high build thick layers is polyol isocyanate, which is not possible in waterborne systems (foam). Alternative 2-K technologies fail on other technical reasons, and 1-K products don't allow a "durable" repair of a vehicle.' However, CEPE proposes to move two specific primer coatings from category (e) with 840 g/l to category (c) with 540 g/l (see chapter 3.2). [CEPE, 2008c]

Technical issues preventing further VOC-reductions would include wetting and adhesion, as well as the ability to achieve a proper mixing and distribution of filling agents in the primer. According to end users (AIRC), primers with a VOC-content below 250 g/l that have been on the market were offered by only one supplier. Besides, they were 'general metal primers' instead of high performing primers that are specially designed for vehicle refinish (they are used on e.g. garden fences), and they were very low performing products.

Washprimer (cat. c subcategory iii): The current VOC limit is 780 g/l. The products have been specifically designed for corrosion protection on aluminium parts. CEPE's position is that 'there is no alternative technology for these very thin layers that bring excellent adhesion and corrosion protection on bare metal. Therefore 780 should remain as a limit.' CEPE considers the volume as small, without giving detailed figures. [CEPE, 2008c]

Topcoats – general (cat. d): The current VOC limit is 420 g/l. The group comprises two coating systems: 1-layer topcoats and 2-layer topcoats (basecoat-clearcoat).

CEPE states that the use of 1-layer topcoats is 'rapidly declining'. For the 2-layer topcoats, water-based basecoats are state of the art, containing 100-140 g/l VOC and solvent-based clearcoats at 420 g/l VOC. annex II B of Directive 2004/42/EC prescribes declaring the VOC content of vehicle refinishing products of categories (b) to (e) after discounting the water content. Therefore CEPE states that water-based products need a VOC limit of 420 g/l.

2.6. End users (AIRC/CECRA) on stricter VOC limits for vehicle refinishing products

In order to obtain end user opinions on potential stricter VOC limits for vehicle refinish coatings, questionnaires were distributed among member associations of the Association Internationale des Réparateurs en Carrosserie (AIRC) and the European Council for Motor Trades and Repairs (CECRA).

AIRC has members in 14 countries (incl. Croatia and Switzerland), which represent vehicle refinish companies. CECRA has members in 20 countries (incl. Norway and Switzerland) and does not represent vehicle refinishing companies, but in most cases 'general' garages, where the relative share of vehicle refinish activities varies widely.

AIRC responded to the questionnaire as well as six CECRA members (DE, DK, HU, NO, SE, SF).

In addition, two in-depth interviews were held with the AIRC policy-adviser on social affairs and environment [Horak, 2008], [Horak, 2009].

Table 61 presents basic data on the general garage and vehicle repair sector provided by CECRA member associations that responded to the questionnaire so far.

Table 61: Basic data of garage companies partly carrying out vehicle repair and refinish in Europe

	DK	HU	NO	SE
Companies < 5 employees	20%	78%	80%	80%
Average margin of profit	15%	30-40%	?	7%
Overcapacity in the sector?	yes	yes	yes	yes
2007 limits problematic?	no	no	no	no
Stricter limits problematic?	no	yes	no	yes

[CECRA, 2008]

The interview with AIRC has provided the following information on the sector:

- Vehicle repair companies in the EU are under pressure as a result of over-capacity – caused by less accidents as a result of safer cars and safer road design – and pressure from insurance companies to cut costs;
- As a result, the number of VR companies in the EU is continuously decreasing; e.g. in the UK the number has decreased by 50% in only a few years;
- The average margin of profit of specialised vehicle refinish companies organised in AIRC has dropped to 1% EU-wide, making it hard to do investments. In the UK, Germany and the Netherlands the switch towards low-VOC basecoats was made some years before already, when the economic situation of vehicle refinish companies was more profitable;
- Major investments (to improve drying conditions in spray booths) have been necessary to comply with the 2007-limits. Therefore, further limitations might be easier to comply with – *as far as the coatings are available*.

AIRC has confirmed the observations on the feasibility of reduced VOC limits for vehicle refinish coatings made by CEPE. Hence, AIRC regards the additional VOC reduction potential in vehicle refinish products as marginal.

VOC reduction by alternative technologies, such a 'spot repair' (reducing the total amount of paint used), are considered as more promising.

[Horak, 2008]

2.7. Emerging techniques enabelling stricter VOC limits for vehicle refinishing products

Topcoat systems are classified as vehicle refinishing products category (d). They may consist of one or two layers. The two-layer system is called 'base-coat-clearcoat system'. It is predominant in the vehicle refinish sector. In this two-layer system, water-based basecoats are dominant. [Horak, 2008] [CEPE, 2008c]

A major area in which emerging techniques may come up is water-based clear-coats. As clearcoats represent the top-layer of the total vehicle coating system, they have to meet high demands with respect to gloss retention, scratch resistance and chemical (gasoline) resistance.

Paint manufacturers have been working on the development of water-based clearcoats for years. Technical magazines have been publishing regularly on the developments. It has been reported that under optimal application conditions (e.g. elevated temperatures, low humidity) water-based clearcoats can perform as well as solvent-based clearcoats – with respect to the aspects of gloss retention, UV-resistance, scratch resistance and chemical resistance. [Fleck, 2000] [Krüger, 2000] [Grace, 2000] [Pires, 2002] [Athawale & Peshane, 2002]

However, the same publications indicate that the products do not have yet the 'robustness' that is needed to perform under varying circumstances. Discussions with industry (annexes 32, 34 and 35) have indicated that this situation has not changed, yet. Thus, vehicle refinishing companies as well as their customers and insurance companies are not yet ready to take the risk of applying water-based clearcoats.

Annex 3

3. Implementation problems

3.1. Problems related to the definition of 'buildings'

The scope of Directive 2004/42/EC regarding paints and varnishes according to annex I No 1 of Directive 2004/42/EC is restricted to *'coatings applied to buildings, their trim and fittings, and associated structures for decorative, functional and protective purpose'*.

The missing definition and subsequent varying interpretation of *'buildings, their trim and fittings, and associated structures'* is mentioned in reports of three Member States (CZ, PT, SK) as a main implementation problem of Directive 2004/42/EC. [CZ Report, 2008] [PT Report, 2008] [SK Report, 2008]

In the project questionnaire, Member States have been asked:
*"Have you observed problems because of the definition of' 'building'?
Please describe. Any suggestions?"*

Answers were given by 22 Member States. 8 Member States (BG, CY, CZ, DK, LV, SE, SI, SK) reported problems and 14 Member States (AT, BE, EE, EL, ES, FI, HU, IE, LT, MT, NL, PL, RO, UK) stated, they had no problems

Table 62 gives an overview on the four types of answers of Member States regarding problems with the definition of 'buildings'.

Table 62: Problems with definition of "buildings" reported by Member States

Different interpretations of the definition hinders clear definition of the scope	Different interpretations of the definition hinders harmonisation of the markets	Referring to 'building' and 'associated structures' excludes products from the scope	No Problems
LV, SE	SE, SI	BG, CY, CZ, SK	AT, BE, EE, EL, ES, FI, HU, IE, LT, MT, NL, PL, RO, UK

3.1.1. Description of the problems

3.1.1.1. Different interpretations of the definition of 'buildings, their trims and fittings and associated structures' hinders clear definition of the scope

Latvia and Sweden state the problem, that different definitions of 'building' and its defined parts exist, "especially, when it comes to the area of interpretation of what "'parts, trimmings and fittings' actually are" [SE Quest, 2008; SE Pers, 2008] and regarding the question whether "under this definition are also bridge-constructions, electrical-stake, containers and other large-size constructions" [LV Quest, 2008].

3.1.1.2. Lack of definition of 'buildings, their trims and fittings and associated structures' hinders harmonisation of the European markets

Sweden [SE Quest, 2008] and Slovenia [SI Quest, 2008] state, that disagreement in the definition of 'building' leads to different interpretations of the scope and therewith to problems "to some extent not regarding the national implementation but on the EC-level, when different interpretations and implementations are done in the different EC member states" [SE Quest, 2008]. This may result in a hindrance of the harmonisation of the European markets.

3.1.1.3. Exclusion of products by restriction of the scope to 'buildings, their trims, fittings and associated structures'

Bulgaria [BG Quest, 2008], Cyprus [CY Quest, 2008], Czech Republic [CZ Quest, 2008] and Slovakia [SI Quest, 2008] mention as a problem, that restricting the scope of the Directive to '*buildings, their trim and fittings, and associated structures*' would cover the paint for a wooden house-cladding but not the "paint for a bench in the garden" [SK Quest, 2008]. "Products used to varnish furniture do not fall within the scope of the Directive" [CY Quest, 2008].

Austria does not see the problem because "paints suitable for buildings may be used for other things as well, hence most products are covered by the Directive" [AT Pers, 2008]. Belgium also argues that "'non-building' specific decorative products are rare" [BE Quest, 2008].

Manufacturers may avoid that a product falls under the directive by dedicating it to movable furniture. By doing so they would unnecessarily dispense this product from a part of the market. Therefore, Austria argues that the market may regulate the compliance of the products with the Directive. [AT Pers, 2008]

3.1.2. Member States suggestions to solve problems related to the definition of 'buildings'

Suggestions for solving problems related to the definition of 'buildings' were made by 8 Member States (AT, BE, BG, CZ, FI, RO, SE, SK) – not all of them having reported particular problems related to the term.

Three Member States (FI, RO, SE) suggest a clarification of the definitions. Finland proposes, the definition of trims, fittings and associated structures "should be clarified, for instance through examples" [FI Quest, 2008].

Romania suggests to "specify the title of the Directive to avoid different interpretations*: 'Directive ... on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints, varnishes <u>for buildings</u> and vehicle refinishing products'"* [RO Quest, 2008].

Sweden accredits, that "the European Commission and the EC Member States strive to solve this by developing answers on FAQs" [SE Quest, 2008].

Two Member States (AT, BG) propose an extension of the scope supporting to solve the problems related to the definition of 'buildings'.

Austria states, that 'constructions' would be a better term instead of 'buildings' [AT Quest, 2008], because constructions would cover a wider range of scope. "Most of the paints used for buildings are also used to coat diverse types of constructions. Paints intended for exclusive use on constructions (and not suitable for buildings) have not been found so far." [AT Quest, 2008]

Bulgaria suggests extending the scope by the extension of the definition of 'building', because "moveable furniture also belongs to the building; that is why they should be included in the definition of the building" [BG Quest, 2008]. The definition should "as well cover items such as movable furniture […], doors, radiators, bath-tubes, tiles, etc" [BG Quest 2008; BG COM 2008].

Three Member States (BE, CZ, SK) recommend an extension of the scope of the Directive. [SK Quest, 2008] [CZ Quest, 2008]

Czech Republic suggests "not to be too focused specifically on the type of coated object (building etc.)" but to use more general specifications, "for example paints for wood, stone etc", "regardless of whether we use it on the buildings, windows, furniture, etc" [CZ Quest, 2008]. Belgium proposes to define products by "type of surface and effect on the surface" [BE Quest, 2008], which means, products should be dedicated for the use on metal, glass or wood.

3.1.3. Extension of the scope to the entire wood coating sector

In order to receive background information on the feasibility of low-VOC coatings in the timber industry an interview was held with SHR Timber Research in the Netherlands (see Annex 41) [Lutke Schipholt, 2008].

SHR is the main Dutch timber research institute in the field of technical and coating research. The timber industry produces wooden parts for buildings, such as window-frames, doors, stairs etc. Because wood coating is part of the process, Directive 1999/13/EC applies if the VOC consumption is higher than the threshold of 15 kt.

Some Member States have applied Directive 2004/42/EC to wood coating installations below the 15 kt threshold, some have not. In the Netherlands, the timber industry has to apply wood coatings containing max. 150 g/l VOC since 2004. This means, that only water-based coatings can be used.

Based on the experiences in the Dutch timber industry since 2004, the interview revealed the following main conclusions:

- The limits in Directive 2004/42/EC are too soft, because they allow the option to use solvent-based coatings;
- Water-borne coatings perform *at least* as well as solvent-based coatings in the timber industry; however, both among water-based *and* solvent-based coatings large difference in quality can be seen;
- Water-borne coatings are technically as well as economically (investments, energy costs, material cost, production cycle) feasible in all timber companies, including SMEs (far) below the 15 kt threshold. This is caused by the fact that each company can choose any of two options:

1) invest in drying equipment, i.e. conditioned production circumstances (allowing shorter production cycles),
2) accept longer drying times with less investment. Both options have proven to result in high-quality finishes.

The Dutch timber industry, its customers and the paint industry have jointly set-up a certification system that guarantees the quality of the final products, if produced with water-based coatings. The certification scheme prescribes specific drying conditions (temperature, humidity) in combination with specific drying times. Details on the options and on how these can be achieved are available in the interview report (see annex 15).

In conclusion, *application of the VOC limits in directive e 2004/42/EC to wood coating installations not in-scope of directive 1999/13/EC (i.e. below the 15 kt threshold) has been proven feasible, and should be no problem*.

A number of novel technologies are emerging. These may provide cost-efficient options for those companies that yet have to start investing in low-VOC technologies. They include:

- the use of UV-drying coatings (including water-based variants);
- the use of 2-pack polyurethanes;
- the use of powder coatings.

A final remark made, was the fact that furniture coatings may require a different approach. In a number of cases, the feasibility of water-based coatings in this industry is less than in the timber industry. This is related to high demands with respect to gloss, scratch resistance, chemical resistance (cleaning agents), and the use of specific wood types (e.g. oak).

3.2. Problems related to current test methods

3.2.1. Problems reported by Member States and stakeholders

Directive 2004/42/EC prescribes in annex III two methods to analyse the VOC content of products under the scope: ISO 11890-2 and ASTMD 2369, specifying that the latter has to be applied where reactive diluents are present.

Since annex I 1.1 (f) defines that ‘minimal build woodstains’, have a mean thickness of < 5 µm, ISO 2808:1997 is prescribed to determine the mean thickness.

Member States and stakeholders have been asked to report on problems with the test methods.

Table 63 gives an overview on the answers given by Member States regarding the analytical methods. Answers have been received from 22 Member States.

Table 63: Problems with the analytical methods reported by Member States

Need for inclusion of method ISO 11890-1	Lack of accredited laborato-ries	ASTMD method is not fit for purpose	Financial reasons hindering application	Method not used yet	Typical problems of gas chroma-tography	No Problems
CZ, EE, LT, MT, PL, SK, RO	BG, CY, DK, LT, MT, PT, SI	DK, LT	FI	ES, SE	AU	BG, CY, DE, EE, EL, HU, IE, LV, MT, NL, PL, UK

12 Member States out of 22 (55 %) answered that they did not have problems with the analytical methods. Sweden and Spain reported that they have not used the method yet. Austria reported typical problems of gas chromatography as such: '*the methods displayed the general sensitivity patterns of GC analysis, in particular dependence on column material, temperature (+gradient), gas flow, etc.'* [AT Quest, 2008]

9 Member States have reported specific problems when using the method.

Additional consultations at laboratories and stakeholders such as CEPE and national associations of paint manufacturers have been undertaken. They revealed partly similar comments as made by Member States.

The problems reported are:

a. Lack of laboratories (chapter 3.2.2)

b. Lack of financial resources (chapter 3.2.3)

c. Need for inclusion of latest test method versions (chapter 3.2.4)

d. Need for inclusion of method ISO 11890-1 (chapter 3.2.5)

e. ASTMD 2369 wrongly understood (chapter 3.2.6)

f. ASTMD 2369 not suitable for polyester putties/moisture-curing products (chapter 3.2.7)

g. Test of layer thickness of woodstains not suitable (chapter 3.2.8)

3.2.2. Lack of laboratories

Seven Member States reported having a lack of laboratories in their countries accredited to carry out the prescribed analysis methods.

The inquiry was made 18 months after Directive 2004/42/EC coming into force, and only 6 month after 1 January 2008, key day for non-complying products - produced before 1 January 2007 – being no longer allowed to be placed on the market. Feedback on existence of national monitoring programmes has revealed that most Member States started monitoring in 2008.

On this background it is supposed that there was only a limited demand yet for undertaking tests according to the methods described by Directive 2004/42/EC.

The project team expects that more accredited laboratories will be available with increasing implementation of monitoring programmes creating demand for application of the test methods. It is expected that accredited laboratories will emerge. In the meantime, Member States may commission the work to accredited laboratories abroad, as has been reported by some Member States.

3.2.3. Lack of financial resources

Finland reports that the methods are advised but not used for financial reasons: 'Authorities have very limited resources to take samples or use these analysis methods. In practice it seems that these methods will be used very rarely if not at all. It is advised in the monitoring program to use these methods when samples are taken and analysed. Apparently according to the present Finnish legislation it is not possible to divert the bill of costs to the companies even though they have operated against regulations, so in practice these analysis methods will not be commonly used. According to the stakeholders it seems that these experimental methods are used quite rarely to verify content of VOC compounds. Companies mainly use mathematical methods to determine VOC content.' [FI Quest, 2008]

Article 3 of Directive 2004/42/EC prescribes:
'For determining compliance with the VOC content limit values set out in annex II, the analytical methods referred to in annex III shall be used.'

The project team considers the lack of financial resources for undertaking compliance checks of Directive 2004/42/EC as a significant problem.

If less costly standardised methods would exist that provide results of similar accuracy, it would be worthwhile considering a correlating amendment of Directive 2004/42/EC. However, there are no indications that such cheaper methods are available.

However, it has appeared that part 1 of ISO 11890 ("difference method") is such a cheaper test method. **Part 1 of ISO 11890 is recommended in part 2 of ISO 11890 for determination of the VOC content of paints containing more than about 15 % VOC by mass** because it is regarded as being easier to apply than part 2 of ISO 11890 ("gas-chromatographic method").

ISO 11890-2 is currently prescribed in Directive 2004/42/EC as the only method for products not containing reactive diluents. However, as in the text of this method itself it is recommended to use the less complicated method ISO 11890-1, in fact that method is already allowed as an alternative, less costly method (see chapter 3.2.4).

A consultation of two laboratories in the Netherlands and Germany has revealed that the relative costs of method ISO 11890-2 compared with costs of ISO 11890-1 range from 4.5:1 to 4:1. It was indicated that the absolute costs of method ISO 11890-2 are about 700 Euro's, without reporting and VAT.

An assessment of the national monitoring programmes has revealed that cost allocation may be regulated on a national level in such a way, that companies placing products on the market are obliged to be able to present and pay for analyses results according to the test methods.

3.2.4. Need for inclusion of latest test method versions

CEPE has proposed to enable the use of the latest versions of the test methods prescribed for VOC by deleting the last table column in annex III of Directive 2004/42/EC, currently prescribing the use of standard test methods published in determined years.

Updates of standards are discussed and decided by members of the standardisation body. The Commission may influence the standardisation process by taking part in the Technical Working group of a standard, but the outcome of any upgrade of standards can not be stopped or blocked if the results would differ significantly from the intention of the former standard.

On the other hand, updated standards may include improvements and hence may be advantageous to be used in the context of Directive 2004/42/EC. This effect may also be achieved in regular review and amendment procedures.

The project team proposes that the Commission assesses the legal aspects of this proposal (common practice in other legislation referring to standards).

The project team has consulted two laboratories in order to assess the differences between ISO 11890-2:2002 and ISO 11890-2:2007 and evaluate benefits of a substitution of the current standard by the updated standard version. The answers received were the following:

- The differences between both methods are minimal;
- In ISO 11890-2:2007 a ‘marker component’ is introduced. According to one laboratory, the benefits of the marker were not clear; according to the other, its use is a “better determination of the upper limit (boiling point 250°C)” which defines a ‘solvent’ in the current directive.
- The costs of both methods do not differ, according to one laboratory. According to the other, the costs do not differ for 1-component products, but the costs of the 2007-method are slightly higher for 2-component products (+ 5%);
- Both laboratories do not expect that any problem would arise from using the updated (2007) version. One indicates that there will be a slight improvement in the quality of the analysis.

3.2.5. Need for inclusion of method ISO 11890-1

The standard method ISO 11890 is named 'Paints and varnishes - Determination of volatile organic compound (VOC) content' and consists of two parts:

- ISO 11890-1: 'Difference method'
- ISO 11890-2: 'Gas-chromatographic method'

annex 3 of Directive 2004/42/EC prescribes only ISO 11890-2 for the determination of the VOC content of all coatings not containing reactive diluents.

ISO 11890-2 characterises the scope of this piece of the method as following:

"(…)This part is preferred if the expected VOC content is greater than 0,1 % by mass and less than about 15 % by mass. When the VOC content is greater than about 15 % by mass, the less complicated method given in ISO 11890-1 may be used (…)." [ISO 11890-2:2007]

A number of Member States and stakeholders have reported a deficiency in the fact that Directive 2004/42/EC prescribes only the use of part 2 of the method.

Czech Republic reported that 'ISO standard 11890-2 does not fully analyze the spectrum of paints'; therefore also ISO 11890-1 is used for monitoring. [CZ Quest, 2008]. *Slovak Republic* regards ISO 11890-2 as non-applicable for VOC concentration above 15% [SK Quest, 2008]. Likewise *Estonia* 'has adopted ISO 11890-2 with ISO 11890-1/2' [EE Quest, 2008].

Malta reported that 'Solvent borne products were analysed according to EN ISO 11890-1 and water-based products were analysed according to EN ISO 11890-2' [MT Quest, 2008].

Poland reported: 'For certain products the VOC content was additionally determined in external accredited laboratories where tests were carried out using both the differential method and the gas chromatography method, in accordance with the Standard PN-EN ISO 11890-2: 2002. When the two methods are found to be consistent most manufacturers only apply the differential method, which is substantially cheaper.' [PL Rep, 2008].

The project team has assessed the inclusion of ISO 11890-1:2007 as an additional method for VOC content determination, recommended for products not containing reactive diluents and providing of a VOC content of > 15 % by mass. Member States, stakeholders and two laboratories were asked to provide additional comments.

The responses – as well as the text of the standards itself - indicate that the statement that "ISO standard 11890-2 does not fully analyze the spectrum of paints" is not correct. The gas chromatographic method ISO 11890-2 is capable of analysing the full spectrum of paints - if no reactive solvents are involved. However, the standard 11890-2 states that it is *recommends* to use the less complicated difference method 11890-1 when the VOC content is above 15%.

As indicated above, in the text of method 11890-2 itself it is recommended to use the less complicated method ISO 11890-1 if the VOC content is above 15%, in fact that method can be considered as already indirectly allowed as an alternative, less costly method – even if no direct reference to that method is made in Directive 2004/42/EC. A direct reference to method 11890-1 should be introduced in the text of the Directive, but formally this will not have any impact. However, in order to prevent any misunderstandings among Member States or stakeholders, a direct reference to the method is advisable.

The relative costs of method ISO 11890-2 vs. ISO 11890-1 range from 4.5:1 to 4:1. If Member States (and stakeholders) that did not yet use method 11890-1 start using it for paints with a VOC content higher than 15%, the cost savings may be about 75% per sample of these paints. However, as these relative costs – indicated by two laboratories - disregarded reporting costs, the actual savings may be a little lower.

3.2.6. Non-suitablility of method ASTMD 2369 in general

ASTMD 2369 is the test method prescribed by annex III of Directive 2004/42/EC to be used for VOC content determination if reactive diluents are present.

One Member State reported problems with the method ASTMD-2369. Apparently these problems seem to be based on a misunderstanding of the prescription of the directive. In contrast to what the Member State had assumed method ASTMD-2369 is *not* suitable for decorative paints in category (d) or for other paints not containing reactive diluents.

As specified in annex 3, the ASTMD method is only prescribed for paints that contain 'reactive diluents'. 'Reactive diluents' are diluents (VOC) that react chemically with other paint components, and which are therefore 'captured' in the final dry film. Generally, paints that contain reactive diluents are two-component products (e.g. epoxy or polyurethane coatings). After mixing a base-component (resin + reactive diluents) with the hardener-component, the chemical reaction starts. Because of the chemical reaction, only part of this 'reactive diluent' will evaporate and emit to the environment. The method ASTMD 2369 was specifically developed to cope with this reaction. The method is carried out in such as way that only those solvents are determined as VOC that emit to the environment.

The same Member State questioned whether the ASTMD 2369 method for VOC content determination of products containing reactive diluents is fit for purpose, claiming that the required test temperature (110°C) would be much lower than the boiling point definition of tested VOC (250°C), as specified in article 2 (5) of Directive 2004/42/EC.

In practice, this difference has no relevance for the test results. The ASTMD test is carried out at an elevated temperature (110°C) in order to speed up the test. However, it is not needed to heat up the coating to 250°C to achieve evaporation of diluents with a boiling point below 250°C because diluents will also evaporate at much lower temperature, phenomenon that can be observed at normal ambient temperatures, also (20°C).

3.2.7. Non-suitability of method ASTMD 2369 for polyester putties and moisture-curing products

One Member State reported that the ASTM 2369 method would not be suitable in the specific case of 2-component polyester putties (fillers) [DK Letter, 2007].

These products are covered by the scope of Directive 2004/42/EC, classified in annex I (2.1) vehicle refinishing products under category (b) 'bodyfiller/stopper'.

As described in chapter 3.2.6, test method ASTMD 2369 is mainly used for determining the VOC content of 2-component products that contain chemically reactive diluents. In case of epoxy and polyurethane coatings, which are the most relevant product types in this respect, the method is fit-for-purpose and no problems have been reported.

However, in polyester putties the ´reactive diluent´ is styrene. Generally, polyester putties contain about 30-40% of styrene and 60-70% of polyester resin. The curing reaction (co-polymerisation of polyester resin with styrene) is started by adding an initiator, which is peroxide [DK Letter, 2007]. As the reaction is not stoichiometric, styrene in excess will remain and will emit to ambient air.

ASTM D 2369 methods requires that the test product is thinned with a 6-10 times higher amount of solvent. The problem with dilution of polyester putties is that the radical co-polymerisation does not work in the same way as in the non-diluted product. Start radicals or start of chain reaction may 'die'. Polyester materials are very sensitive to thinning, and the curing reaction will change by adding low percentage of solvent. After the 'induction period' of 1h (or more as allowed in the test method) no start radicals will be generated which means that there is no post curing in the oven.

Consequently, the fraction of the emitting part of the solvent cannot be determined. In addition, technical problems related to the viscous, ´sticky´ nature of the polyester putty product hamper the correct execution of the ASTMD 2369 method.

So far, a suitable test method for polyester putties is unknown, and consequently no solution is available for this problem at present. This was also affirmed by CEPE Technical Committee Vehicle Refinishes [Warnon, 2008a].

However, CEPE has stated that the problem would not be relevant as current polyester putties would always generate lower VOC emissions than allowed for in annex II-B of Directive 2004/42/EC for category (b) products (max. 250 g/l) [Warnon, 2008a].

Member States have been asked for feedback in case they have been confronted with the problem. Besides the Member State that first raised the problem (DK), one answer was received, reporting that the ASTMD method is not applied (EE).

3.2.8. Test of film thickness for woodstains not suitable

CEPE has identified a problem when determining the film thickness of decorative coatings category (f) – 'minimal build woodstains'. annex I (1.1 f) of Directive 2004/42/EC prescribes to use standard ISO 2808:1997 method 5A to classify woodstains according to their film thickness.

However, CEPE has underlined that this method needs further clarification in order to provide accurate results. CEPE has proposed an additional *annex 4* to the directive, providing the following wording for clarification:

> "The film thickness is always to be measured on the wood substrate. Only the film above the wood surface is included. The method to be used is ISO 2808 method 5A that describes:
>
> - Measurement of dry film thickness by microscopic method
> - Recommended for film substrates of varying profiles
>
> The replica shall be produced according to description in EN 927-3 with 5 measurements on 3 chips and the mean value in microns is recorded. The film thickness is measured for the total coating system." [CEPE, 2008a]

Two Laboratories were asked to provide comments to this proposal. One did not carry out measurements of the film thickness of coatings. The other responded that no problems are expected to result from the proposed additional explanation. This laboratory usually uses a similar microscopic method to determine film thickness.

3.3. Problems related to an overlap of Directive 2004/42/EC and Directive 1999/13/EC

3.3.1. Problems reported by Member States

All Member States have been inquired whether they have observed problems because of an overlap of Directive 2004/42/EC and Directive 1999/13/EC. They were requested to describe the problem and to make suggestions to solve it.

Answers were given by 22 Member States, of which five reported to have problems with overlap, another one claimed that interaction is unclear; three Member States reported that the overlap is a *main* implementation problem.

Table 64: Problems with Directive 1999/13/EC overlap reported by Member States

Interaction between Directive 1999/13/EC and Directive 2004/42/EC is unclear	Double use / dual use of products possible	National implementation of Directive 1999/13/EC may reduce the scope of Directive 2004/42/EC	Companies expected having competitive disadvantages near the boarder	No Problems
UK	AT, FI, LT, RO, SE	SE, DK	DK	BE, BG, CY, CZ, EE, EL, ES, HU, IE, LV, MT, NL, PL, SI, SK

One Member State reports “confusions” as for manufacturers “the interaction between the Paints Directive and Solvent Emissions Directive is difficult to comprehend” [UK Quest, 2008]. As manufacturers would not know, if the product might be used for a porpuse under Directive 2004/42/EC or under Directive 1999/13/EC, it would not be clear to them, whether they have or have not to comply with the provisions of Directive 2004/42/EC. [UK Quest, 2008]

Several Member States received comments that industry would have difficulties due to the possibility of "double use" or "dual use", and reporting would be bring along difficulties e.g. “supervising the dual use when same products are covered in both Directives (1999/13/EC and 2004/42/EC) and requirements are depending on who is the user or what is the purpose of use” [FI Quest, 2008].

Sweden and Denmark mention a problem arising from the legal interaction of the two directives: Directive 2004/42/EC is based on Article 95 EC Treaty, protecting the free movements of goods in the European Union, not allowing individual stricter limit values. The directive refers in Article 3(2) to Directive 1999/13/EC, allowing derogations: *“By way of derogation from paragraph 1, Member States shall exempt from compliance with the above requirements products sold for exclusive use in an activity covered by Directive 1999/13/EC and carried out in a registered or authorised installation according to Articles 3 and 4 of that Directive.”* Directive 1999/13/EC is based on Article 175 of the EC Treaty. This legal basis leaves the choice to Member States to implement Directive 1999/13/EC at least with the limit values and the scope as proposed in the directive or with stricter limit values and covering a wider scope. Thus, the scope and limit values of the national implementations of Directive 1999/13/EC nowadays differ between the Member States.

Taking those facts as background, the following problem is identified: If the reference in Article 3(2) to Directive 1999/13/EC includes a reference to the individual national implementation of Directive 1999/13/EC with potentially widened scope, than as well the scope of Directive 2004/42/EC differs between Member States. As Directive 2004/42/EC bases on Article 95 EU Treaty, this would not be allowed as it hinders a harmonisation of the European markets.

Sweden asks for clarification of the question whether Article 3(2) of Directive 2004/42/EC only refers to the exact scope defined in Directive 1999/13/EC or whether it may also refer to an extended scope in cases where national implementation differs from the minimum scope defined in Directive 1999/13/EC due to lower threshold values for certain activities. [SE Quest 2008; SE Pers 2008]

Denmark reports a statement made by industry, saying that being covered by Directive 1999/13/EC means that a manufactory has a higher flexibility in choosing products compared to a manufactory not covered by Directive 1999/13/EC. [DK Quest, 2008].

3.3.2. Member States suggestions to handle the overlap of Directive 2004/42/EC and Directive 1999/13/EC

Suggestions where made by 4 Member States (DK, LT, UK, SK), which were not necessarily those which reported problems.

3.3.2.1. Identification of possible overlaps

The United Kingdom [UK Quest, 2008] as well as Lithuania [LT Quest, 2008] suggest to clearly identify the scenarios, when products are affected by one or both Directives. "…perhaps some guidance detailing different scenarios when one or both directives would apply would be helpful." [UK Quest, 2008]

3.3.2.2. Labelling of products covered by Directive 1999/13/EC

Slovakia suggests labelling double-use products which do not comply with the VOC limit values of the Directive 2004/42/EC. "Paint is only for use in installation according to Directive 99/13" [SK Quest, 2008]. Denmark states, that "some companies put a label on products covered by the Emission directive. They are not for sale for the general public" [DK Quest, 2008].

3.3.3. CEPE comment on 'in-situ' introduction

CEPE proposes to restrict the obligation of using products under the scope of Directive 2004/42/EC to applications realised 'in-situ', meaning any application outside of installations. CEPE argues that by defining this reduction of the current scope, uncertainties would be avoided whether an activity realised in an installation is covered by the scope of Directive 2004/42/EC or not. The arguments of CEPE can be found in annex 0.

A restriction to "in-situ" applications was foreseen by the original proposal of the Commission and its consultants when Directive 2004/42/EC was set up, but changed due to discussions in the Parliament. The chance made by the Parliament is easier to monitor because any decorative coating has to comply with Directive 2004/42/EC if placed on the market and designed to be used in the building sector, respectively to be "applied to buildings, their trim and fittings, and associated structures for decorative, functional and protective purpose."

The problem arises from the possible "double use" of coatings, meaning good performance for both, building sector and other applications like furniture.

Coatings suitable for the building sector may also be used for applications outside the building sector which broadens the use of VOC-restricted coatings. But this is also true the other way round: Coatings designed for other applications than the building sector may be designed and labelled for exclusive use on furniture, but may also perform well if applied to "buildings, their trim and fitting, and associated structures".

Many coatings designed and labelled for interior furniture (made of wood, plastic or metal) also perform well as interior coatings for the building sector, less frequent for exterior applications in the building sector.

If coatings are designed and labelled for exterior furniture coating, they can normally be applied for exterior and interior as well as for furniture and building sector, hence such products without VOC limitation can be "misused".

3.3.4. AIRC comment on vehicle refinishing

AIRC (Association International des Reparateurs en Carrosserie) has reported that major enforcement problems may arise at companies combining several types of activities: e.g. vehicle refinish and original coating of adapted commercial vehicles when being produced in that company. Problems identified include:

Various coating activities on one vehicle may be covered by both directives

Companies specialised on 'custom-made' trucks purchase a 'bare' truck from an OEM (original equipment manufacturer), only consisting of the chassis and the cabin. Subsequently, the company constructs the rest of the truck (e.g. a horse-transportation truck, trucks for refrigerated transport, etc.). The cabin and chassis have already been coated at the OEM, and the rest of the truck will be coated by the company. Frequently, customers desire another coating of the cabin and the chassis to achieve corporate design colours which combine with the rest of the truck. Therefore, the newly built parts as well as the cabin and the chassis are coated.

- The cabin coating is a refinishing activity
  => Directive 2004/42/EC products have to be used;
- the rest of the truck is 'original coating'
  => this is covered by Directive 1999/13/EC

Even if products complying with Directive 2004/42/EC are used for all parts, Directive 1999/13/EC also applies; therefore the company has to fulfil all related requirements (register, solvent management plan, achieve emission limits etc.).

Companies carrying out several types of activities – both directives apply

A common combination is: custom-made truck construction (original coating) and truck repair (refinishing). Similar overlaps occur as mentioned above.

General comment

AIRC claims that the use of the term “refinish” is confusing in Directive 1999/13/EC as the definition in some cases refers to ‘original coating’.

Conclusion of AIRC

The ‘double’ obligations in a number of cases imply an additional administrative burden for the companies as well as for the authorities that have to enforce the regulations. Enforcing Directive 1999/13/EC is more complicated for companies than being under the scope of Directive 2004/42/EC. Therefore, it would be simpler to bring all vehicle coating activities other than original manufacture of cars and trucks (in automated production lines) in the scope of Directive 2004/42/EC. This would be possible if all coating activities of custom-made trucks (including refinish) could be done with Directive 2004/42/EC compliant products (e.g. for topcoats the VOC limit value is 420 g/l, therefore high solid products have to be used).

3.3.5. Conclusions on overlap of Directive 2004/42/EC and Directive 1999/13/EC

Directive 2004/42/EC regulates the placing on the market of certain products whereas Directive 1999/13/EC is user-oriented and regulates the use of solvents in certain activities if a threshold value is exceeded. As threshold values set by Directive 1999/13/EC are minimum requirements and some Member States have implemented lower threshold values, the same activity may be under Directive 2004/42/EC in one country whereas in another it has to comply with Directive 1999/13/EC.

Overlap of both direcives will always be an issue by nature because the same products have characteristics to be used under the scope of both directives.

Currently, when selling a product, coating suppliers have no legal means to control whether a user is registered under Directive 1999/13/EC or not. This could be solved by creating a legal certificate for those companies being registered as an activity covered by Directive 1999/13/EC and having exceeded the national threshold value. The sale of products with a VOC content higher than allowed by Directive 2004/42/EC and labelled to be used for a determined activities covered by Directive 1999/13/EC could be restricted to those buyers showing a certificate proving to have passed the national threshold value.

This would not solve the problem for those companies carrying out an activity covered by Directive 1999/13/EC and not exceeding the related national consumption threshold. In some cases they do not fall under the scope of Directive 2004/42/EC due to application of coating materials for other means than covered by Directive 2004/42/EC, e.g. cabinetmakers when producing furniture. In this case the companies would not be able to prove by a certificate as mentioned above that they are allowed to purchase products not complying with Directive 2004/42/EC. At present it is only possible to control by casual labour inspections whether products not complying with Directive 2004/42/EC are used correctly or for other means than the designated purpose (the dedicated purpose is normally indicated on the container and in the technical data sheet).

To avoid such misuse and to further reduce VOC emissions, the inclusion of furniture coating into the scope of Directive 2004/42/EC will be assessed as an option. Overlap problems and misuse have been reported from associations representing wood coating activities.

Regarding the overlap in vehicle refinishing activities, some authorities like in Germany and the Netherlands already use the Directive 2004/42/EC requirements for companies that build custom-made trucks. A disadvantage of this approach is the fact that big companies using high amounts of coatings would no longer be obliged to reduce emissions on-site. Some of the products complying with Directive 2004/42/EC have rather high VOC limits (e.g. primers/fillers: 540 g/l), and in the current approach, falling under Directive 1999/13/EC, these companies are forced to install an additional abatement technology.

Annex 4

4. New product groups for vehicle refinishing (option 2 and 3)

4.1. Description of options and background information

4.1.1. Options 2 and 3

Options 2 and 3 seek to amend VOC limits set out in the Directive with respect to products used in the vehicle refinishing sector. Under the two options, it is proposed to add additional limit values for certain products and to shift some products from categories with higher VOC limits to categories with lower ones, as well as adding some additional products to the scope of the Directive as set out in Table 65 below.

Table 65: Options 2+3 on vehicle refinishing products defining subgroup limits and shifting to stricter product categories

<table>
<tr><th>Option No.*</th><th>Summary</th><th>Description</th></tr>
<tr><td>2</td><td>Defining additional VOC limit values specific for water-based vehicle refinishing products in the category B (d) 'topcoat'</td><td>It is proposed that the existing product category (d) 'topcoat' currently setting a limit value of 420 g/l for all kinds of topcoats will be separated into two sub-categories with different VOC limits. The sub-categories will be as follows:
<table>
<tr><th><u>Topcoat Categories</u></th><th><u>VOC limit value (ready-to-use)</u></th></tr>
<tr><td>d-1 Basecoat</td><td>150g/l</td></tr>
<tr><td>d-2 Clear coat</td><td>420g/l</td></tr>
<tr><td>Single layer topcoats</td><td>420g/l</td></tr>
</table>
</td></tr>
<tr><td>3</td><td>Shifting of certain products from the vehicle refinishing category (e) 'special finishes' to categories with stricter VOC limit values</td><td>The proposal is to
(a) clarify the definition of 'special finishes (cat.e)',
(b) move some products to categories c. and d. with lower VOC limits,
(c) split category e. into two subcategories, one with lower VOC limits than the other and
(d) add some products to category e.
Proposed classifications are as follows:
<table>
<tr><th><u>Subtype</u></th><th><u>Current category</u></th><th><u>Proposed category</u></th></tr>
<tr><td>anti-chip coatings
underbody sealers</td><td>Cat e.(840g/l)</td><td>Cat c. (540 g/l)</td></tr>
<tr><td>topcoat:
- metallic or pearl effect, single layer
- high-performance solid colour clearcoats (e.g. anti-scratch and fluorinated clearcoat)</td><td>Cat e.(840g/l)</td><td>Cat d. (420 g/l)</td></tr>
<tr><td>reflective base coats
textured finishes
matt finishes
anti-slip coatings</td><td>Cat e.(840g/l)</td><td>Cat e-2 (540 g/l)</td></tr>
<tr><td>plastic adhesion promoters
tyre paints
rim silver paints</td><td>Not in scope</td><td>Cat e. (840g/l)</td></tr>
</table>
</td></tr>
</table>

		Current category / Subtype / Proposed category/limit Cat e.(840g/l) — anti-chip coatings, underbody sealers — Cat c. (540 g/l) Cat e.(840g/l) — topcoat: -metallic or pearl effect, single layer -high-performance solid colour clearcoats (e.g. anti-scratch and fluorinated clearcoat) — Cat d. (420 g/l) Cat e.(840g/l) — reflective base coats, textured finishes, matt finishes, anti-slip coatings — Cat e-2 (540 g/l) Not in scope — plastic adhesion promoters, tyre paints, rim silver paints — Cat e. (840g/l) Products not mentioned in the table remain unchanged (e.g. fade-out thinner needed for spot repair, which remain in class e.).

Current category	Subtype	Proposed category/limit
Cat e.(840g/l)	anti-chip coatings underbody sealers	Cat c. (540 g/l)
Cat e.(840g/l)	topcoat: -metallic or pearl effect, single layer -high-performance solid colour clearcoats (e.g. anti-scratch and fluorinated clearcoat)	Cat d. (420 g/l)
Cat e.(840g/l)	reflective base coats textured finishes matt finishes anti-slip coatings	Cat e-2 (540 g/l)
Not in scope	plastic adhesion promoters tyre paints rim silver paints	Cat e. (840g/l)

Products not mentioned in the table remain unchanged
(e.g. fade-out thinner needed for spot repair, which remain in class e.).

4.1.2. Background information

The options involve shifting some products from category (e) 'special finishes' to categories with stricter VOC limit values. It has been confirmed by CEPE that, for these products, a lower VOC content than 840 g/l is already state-of-the-art and it will therefore not be difficult to achieve lower levels than are currently in force under the Directive.

Consultation with industry associations has not been able to provide any information regarding the current market breakdown between what products would be compliant and non-compliant if the options were to be introduced. Quantification of impacts for these two options is therefore difficult in the absence of information regarding the number of manufacturers that might be affected and the volume of sales of products at the different VOC limits.

4.1.3. Expected Impacts of the Proposed Option (General Introduction)

Association Internationale des Réparateurs en Carrosserie (AIRC), an international organisation representing the vehicle repair sector, has identified that in general the vehicle repair sector is characterised by a reducing number of vehicle repair shops. This is a pattern observed worldwide although, to compensate for the reduction in numbers of vehicle repair shops, there has been a small corresponding relative increase in their size.

AIRC indicated that they support the proposed changes and stated that as the proposals do not entail a major reduction of VOC content, the effect of the measures on the vehicle repair sector are generally expected to be minimal. AIRC also expects a positive impact of increased clarity in product classification and enforcement of the Directive.

4.2. VOC and ozone reduction potential

4.2.1. Availability of data

The estimations of the reduction potentials per country of the EU-27 plus Croatia and Turkey are based on data for the market of vehicle refinishing products provided by CEPE. This data shows a share of 31 % solvent-based basecoats in 2007.

As data was only available for the Member States of the EU-15 plus Malta and Cyprus, data for 12 additional countries had to be estimated. These estimations were based on figures for gross domestic product (GDP) in the EU-27 Member States plus Turkey and Croatia. The data was extracted from the EuroStat database. In a first step the data given for the EU-15 countries plus Malta and Cyprus was extrapolated to the aggregated figures for the EU-27+2 using the proportion of GDP for the EU-27+2 countries relative to the GDP of the given EU-15 Member States plus Malta and Cyprus. In a second step, the difference between the EU-27+2 aggregate and the EU-15 aggregate was estimated and national data for the 12 additional countries were estimated applying the shares of national GDPs in the total EU-27+2 GDP to the calculated difference in the aggregate figures.

4.2.2. Approach of projection for scenarios in 2010, 2015 and 2020

The impact assessment will cover scenarios for the years 2010, 2015 and 2020. Therefore, data provided for the years 2003 and 2007 had to be extrapolated into these future years. This exercise was accomplished assuming an annually constant growth rate for the whole time period. The so-called compound annual growth rate (CAGR) was estimated based on the data for 2003 and 2007. The CAGR was applied for estimations of future sales of paints in 2010, 2015 and 2020. The growth rate has been estimated for the development of national markets including Malta and Cyprus. Furthermore, the given shares of product types within the ‘topcoat’ categories for 2007 have been assumed constant for the future years. The annual growth rates applied for those EU-27 member states where no data was provided by CEPE reflect the estimated growth rates for the EU-15. It has to be noticed that the growth rate of the EU-15 has also been applied for the estimation of the future development of the ‘cleacoat’ market in the Netherlands as the stated increase in medium-solid products did not appeared to be realistic to experts of the project group.

4.2.3. Description of scenarios and estimation of reduction potentials

The reduction potential for each country of the EU-27+2 was estimated through comparison of the VOC emissions from a “business-as-usual” (BAU) scenario where no regulatory changes will intervene in the market development and a

DECOPAINT-NEW scenario where the above mentioned separations within the topcoat category will be implemented for option 2. For option 3, the DECO-PAINT-NEW scenario analyses an implementation of the shift of certain products from category (e) to categories with stricter VOC limit values. The scenarios are described in more detail in this chapter.

4.2.3.1. Business as usual scenario (BAU)

For the estimation of the BAU scenario for 2010, 2015 and 2020, data as it were provided by CEPE for 2003 and 2007 has been extrapolated applying the above described growth rate. The values for VOC contents of the different product groups are those of the reported period, thus no regulatory interventions have been enforced in this scenario and only the constant development of the market accounts for the changes in total VOC emissions.

4.2.3.2. DECOPAINT-NEW scenario for option 2

The estimations of scenarios with new limit values for VOC contents for products in category (d) have been accomplished for the years 2015 and 2020. An estimation of a reduction scenario for 2010 has not been carried out as the time period for manufacturers for implementing the new limits was assumed to be too short. The market data on consumption of paints for the future scenarios has been estimated as shown for the BAU scenario.

Furthermore, it has been assumed that the reduced VOC limit value of 150 g/l will lead to a complete replacement of solvent-based basecoats by water-based basecoats, i.e. the amount of paints consumed of solvent-based products for the category will be replaced by the same consumption of water-based products. Based on CEPE data for EU-15, two-thirds of all base-coating products in the vehicle refinishing market for 2007 have been assumed to be water-based products and one-third solvent-based products.

For clearcoats and single stage topcoats, the new limit value of 420 g/l does not lead to a change in consumption patterns as this value complies with the existing VOC limit value stated by CEPE.

The reduction potential of the implementation of option 2 was calculated by comparing the total VOC emissions of both scenarios. Table 66 presents the reduction potentials of the option for each of the EU-27 Member States and the total VOC reduction potential for the EU-27. Additionally, national reduction potentials have been estimated for Croatia and Turkey.[55]

A total reduction potential in VOC emission of 3.3 kt for 2015 and 3.2 kt for 2020 has been estimated for the EU-27. Including Croatia and Turkey, the reduction potential for the EU-27+2 results in 3.5 kt for 2015 and almost 3.3 kt for 2020.

[55] For the estimations of the reduction potential an emission factor of 0.95 was applied. Thus, not all of the VOC content is emitted but 5% of the VOC are assumed to remain in the container and are not released into the air. This factor is based on an agreement of experts during the compilation of the German emission inventory.

Table 66 shows extrapolations of option 2 for 2015 and 2020, resulting in a VOC reduction potential of 3.3 kt respectively 3.2 kt in EU-27 in the year 2020.

Table 66: Reduction potentials for option 2 per country, in kt

Country	2015	2020
	kt	kt
Austria	0.05	0.04
Belgium and Luxemburg	0.14	0.13
Bulgaria	0.01	0.01
Czech Republic	0.03	0.03
Denmark	0.06	0.06
Estonia	0.00	0.00
Finland	0.02	0.01
France	0.24	0.18
Germany	0.52	0.46
Greece and Cyprus	0.16	0.17
Hungary	0.03	0.02
Ireland	0.12	0.18
Italy and Malta	0.62	0.61
Latvia	0.01	0.01
Lithuania	0.01	0.01
Netherlands	0.10	0.08
Poland	0.08	0.07
Portugal	0.10	0.09
Romania	0.03	0.03
Slovakia	0.01	0.01
Slovenia	0.01	0.01
Spain	0.44	0.44
Sweden	0.08	0.09
UK	0.47	0.46
EU-27	3.33	3.20
Croatia	0.01	0.01
Turkey	0.12	0.11

4.2.3.3. DECOPAINT-NEW scenario for option 3

For the same reason as in option 2, the estimation of the scenario with new VOC limit values for different products within category (e), i.e. a shift of these products into categories with stricter VOC limits, was estimated for 2015 and 2020 only. Again, the market data on consumption of paints for the future scenarios has been estimated as shown for the BAU scenario.

As there is no data available on the share of products being shifted into the respective categories, am equal distribution of these products has been assumed, i.e. for each of the proposed shift of products, one fourth of the total amount reported by CEPE for category (e) has been assumed to be affected.

Table 67: Reduction potentials for option 3 per country, in tonnes

Country	2015	2020
	kt	kt
Austria	0.001	0.000
Belgium and Luxemburg	0.030	0.042
Bulgaria	0.000	0.000
Czech Republic	0.001	0.000
Denmark	0.001	0.000
Estonia	0.000	0.000
Finland	0.000	0.000
France	0.010	0.004
Germany	0.056	0.049
Greece and Cyprus	0.007	0.011
Hungary	0.001	0.000
Ireland	0.011	0.034
Italy and Malta	0.006	0.002
Latvia	0.000	0.000
Lithuania	0.000	0.000
Netherlands	0.001	0.000
Poland	0.002	0.001
Portugal	0.006	0.006
Romania	0.001	0.000
Slovakia	0.000	0.000
Slovenia	0.000	0.000
Spain	0.059	0.070
Sweden	0.000	0.000
UK	0.024	0.018
EU-27	0.217	0.239
Croatia	0.000	0.000
Turkey	0.004	0.002

The reduction potential of the introduction of the shifts of products according to option 3 was calculated by comparing the total VOC emissions of both scenarios. It can be seen in Table 67 that the reduction potentials for each of the EU-27 Member States and the total VOC reduction potential for the EU-27 slightly increases from 2015 to 2020. This development can be ascribed to the very different national growth rates estimated for this segment of the vehicle refinishing market. This can also be found for the national reduction potentials estimated for Croatia and Turkey. The results presented in the table are provided in tonnes.[56]

[56] For the estimations of the reduction potential an emission factor of 0.95 was applied. Thus, not all of the VOC content is emitted but 5% of the VOC are assumed to remain in the container and are not released into the air. This factor is based on an agreement of experts during the compilation of the German emission inventory.

4.3. Economic Impacts

4.3.1. Impact on public authorities and public spending

Monitoring and administrative cost

Since there will be a number of new products coming under the scope of the directive which were previously not there before, surveillance agents in Member States will likely require some upgrading in their training. Additional costs might also be foreseen in terms of additional testing of new products falling within the scope of the directive. A number of Member States have indicated that they would expect increases in their costs resulting from these options (note that some Member States responded generally, identifying additional costs under "new products", and where this is the case, it is expected that those Member States would incur costs under these options although these would be expected to be less than with other options where the products coming under the scope of the Directive are from completely new sectors).

4.3.2. Investment

Capital investment incurred due to new equipment, reformulation, etc

With respect to manufacturers of vehicle refinishing paints, it is not anticipated that there will be any significant investment costs arising from these options. CEPE (European Council of producers and importers of paints, printing inks and artists' colours) have indicated that they would expect hardly any costs to arise and, whilst some products will need to be reformulated, a sufficient lead-in period should enable manufacturers to adapt their products. Consultation has not revealed any impression that there would be significant costs associated with such reformulation.

There are likely to be some adaptation costs for labelling/IT tools associated with the option where new products are falling under the scope of the directive. CEPE believes that these costs could be considerable, although CEPE also suggests that these costs would be minimised if label changes were harmonised with forthcoming changes stemming from implementation of the Classification Labelling and Packaging Regulation[57], due to come into force for mixtures in June 2015. In other words, if harmonisation in the timing of requirements were to be allowed, then no additional costs would arise specific to these options as labelling changes will occur in any even due to the requirements of the CLP Regulation.

[57] Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006

4.3.3. Impact on competitiveness and trade in relation to trade with non-EU countries

Whilst consultation with trade associations representing vehicle repairers as well as paint manufacturers did not generate any information with respect to trade in vehicle refinishing products between the EU and third countries, CEPE has indicated that it would not expect the introduction of these options to have any effect on the share of European producers in the EU market.

4.3.4. Impact on functioning of the internal market and competition

Number of firms and barriers on new entrants

Since it appears generally the feeling that manufacturers should be able to meet with the requirements of the proposed options without too much difficulty, it is unlikely that any of these companies would be forced to cease operation, resulting in the same number of firms after the introduction of the options as opposed to before. CEPE are in agreement with this analysis indicating that this combined option is unlikely to affect the number of firms; however, they note that this is an uncertain assumption. CEPE has also indicated that there would be no impact on start-up costs for new companies entering the market for vehicle refinishing products, which again is consistent with the predicted limited additional investment likely to be required as a result of the option.

4.3.5. Impact on innovation and research

Other than reformulating some products to meet the revised limits, no significant impacts on innovation and research are expected. The extra costs involved in reformulating products are therefore not expected to detract significantly from companies' R&D budgets or on other aspects of innovation.

4.3.6. Impact on end-users (consumers and professional end-users)

4.3.6.1. Price of product and investment in equipment

According to AIRC consultation response, Options 2&3 would not necessitate substantial investment by the vehicle repair sector. In some cases, minor adjustments of storage facilities may be needed but in most cases adjustment may be achieved without incurring additional investment.

However, in the first stage of this study, AIRC provided a varying response to a more general proposal to reduce the VOC content in vehicle refinishing products. It was stated that many vehicle repair shops across Europe had to invest in new/adapted equipment in order to comply with the 2007 VOC limits. With this investment already made, these companies would not be required to make significant further investment if more stringent VOC limits were put in place. However, as AIRC have pointed out, some vehicle repair shops without sufficient funds available, "kept their old spraying-booths and/or equipment, which results in low efficiency, longer drying times and higher energy consumption." AIRC believes it will be very difficult for these companies to compete in the long run and that at some point or other they will need to invest in new equipment. Whilst the AIRC consultation response that specifically addresses proposed Options 2 &3 does not reiterate this, it is possible that, to an unknown extent, the proposed Options could serve to accelerate those companies having to invest in new equipment.

A member association of CECRA, the European Council for Motor Trades and Repairs responded to a question on whether additional investment would be required by stating that no new equipment would be required by vehicle refinishing body shops which had already adapted to current legislation.

Whilst earlier purchase of such equipment than might otherwise have been the case could be considered as a cost to companies, the investment in such new technology will also bring about benefits. New spraying booths and equipment are more efficient, result in lower drying times and consume less energy than their older counterparts. If these additional benefits are taken into consideration over the life of the equipment, the net costs of the additional investment required in order to efficiently use products that are compliant with the proposed option would be somewhat reduced.

4.3.6.2. Productivity of professional end-users (labour time, re-application)

AIRC expects the proposed options to have only a marginal impact on labour time in the vehicle repair sector and expects no other impacts on operating costs in this sector. In addition, AIRC expects no increase in purchasing price of vehicle refinishing products.

A Slovakian trade association indicated that whilst some new categories of products may increase in price, when compared across the whole product portfolio used in car refinishing, there would be a minimum impact on overall job cost. The association also highlighted the fact that since many products already meet with the requirements of the proposed limits, there are no expectations of any increases in operational costs for vehicle repairers.

4.3.6.3. Quality/availability/consumer choice

CEPE predicts that the option will have no influence on the quality of finish or other factors relating to the product's performance. It is of the opinion that compliant products are already available on the market and that these are well accepted.

AIRC does not expect compliant products to offer significantly worse functional properties. However, it was noted by AIRC that splitting single topcoat and base coat clear coat systems is not desirable, as it will have a negative impact on refinishing of professional transport vehicles where high solids coatings are required. Some water based clearcoats do exist, but these are "young" products and need time to become accepted and established.

The CECRA member association was of the opinion that a number of tried and tested products are already available on the market, and which have no significant disadvantage in performance terms compared with the other higher VOC content products.

4.3.7. Impacts on specific countries/regions

No significant impacts are expected to arise at a particular national or regional level. Where special finishes (which have higher VOC limits under the directive) are used more, emissions savings would be greater as a result of the new proposal, but this is not expected to be significant.

4.4. Social Impacts

4.4.1. Health impacts

The implementation of the options will result in a reduction of anthropogenic VOC emission which may result in a marginal reduction of average ground level ozone concentration in EU-27, Croatia and Turkey. The modelled effects on human health due to this change in the air quality are shown in the following table where average meteorological conditions and the 2020 reference emission scenario have been used. These figures take into account that the VOC reductions within EU-27+2 will also change the exposure of population in neighbouring countries (total Europe EMEP grid). By considering only the impacts within EU-27 and Croatia/Turkey, the externalities will decrease by €694,000 for 2015 and €653,000 for 2020 (option 2).

Table 68: Health benefits due to reduction of VOC emissions and related to ground level ozone reduction

		Option 2		Option 3	
		2015	2020		
reduced external costs	[€_00] [58]	693,678	653,414	47,743	51,009
Mortality	YOLL	4.962	4.674	0.341	0.365
Morbitity RHA, ages over 65	cases	2.81	2.65	0.19	0.21
MDR, ages 18-64	days	11,210	10,559	772	824
RMU by adults	cases	4,072	3,836	280	299
RHA = cases of restricted hospital admissions; MDR = restricted activity days,					

[58] The monetary values reported in this table are expressed in Euro on the basis of the value of the Euro in the year 2000. The estimation of the monetary values expressed in Euros of 2000 enables a comparison of the monetary values estimated for 2015 and 2020.

RMU = cases of respiratory medication use, YOLL = Years of Life Lost

4.4.2. Impact on employment

Due to the fact that no major effect in terms of firms being forced out of business are anticipated as a result of this option, it is also unlikely that there will be any significant employment effects, either positive or negative.

4.4.3. Impacts in the workplace

If new technology is introduced into the workplace in vehicle repair shops in order to apply the new lower VOC containing paints, training may be required on how to operate the new equipment. Given that the technology referred to relates to spraying-booths and equipment, the result may be a more comfortable working environment.

A lowering of VOC content will affect viscosity of paints and since viscosity is also influenced by temperature, there are likely to be some variations across Member States.

4.5. Environmental Impacts

4.5.1. Changes in Ground Level Ozone Concentration

The reduction of VOC emissions may reduce the ground level ozone concentration in Europe. The correlation between the VOC emission reduction and ozone concentration is a non-linear and it is influenced by a number of parameters, e.g. the NO_2 background concentrations and the meteorological conditions have a relevant impact on the processes. The region or country where the VOC emissions are reduced have as well a relevant impact on the European wide changes in the ozone concentration.

The impacts of options 2 and 3 on the ground level ozone concentrations are shown in Table 69. For the calculations average meteorological conditions and the reference emission scenario for 2020 have been assumed. The impacts of the options 2 and 3 have been assessed for the years 2015 and 2020.

Table 69: Impact of options 2 and 3 on the average ground level ozone concentration within EU-27 + Croatia and Turkey.

	average O3 concentration [ppb]	
	changes in [ppb]	percental changes
Option 2		
2015	< 0.001	0.001%
2020	< 0.001	0.001%
Option 3		
2015	< 0.001	< 0.001%
2020	< 0.001	< 0.001%

The ozone reduction may contribute to prevent part of the production losses due to crop damage. The benefit of the VOC reduction due to option 2 has been quantified for 2015 to €366,372 and to €343,543 million for 2020. Option 3 has a much lower contribution of €26,479in 2015 and €28,347 in 2020.

4.5.2. Other Environmental Impacts

Feedback from some stakeholders is that the measure will not involve any significant changes in terms of the use of renewable and non- renewable resources, that there will be no significant changes in transport, fuel consumption or vehicle emissions, and also that no major changes are expected in terms of discharges to water and soil or in terms of waste and recycling. This appears logical since the option will only involve the reformulation of some products (others are already inexistence with state-of-the-art products already having VOC levels at the proposed limits). If vehicle repair shops invest in new spraying technology etc, there may even be environmental gains with the introduction of more energy efficient equipment (although as stated above, companies coming late to this newer technology will need to do so anyway in order to be able to compete in the market, irrespective of whether the new tighter VOC limits are introduced or not).

In contrast, AIRC suggest that there will be a large increase in energy inputs required when applying topcoats, presumably due to the high speed ventilation and heating requirements to expel higher water content.

4.6. Summary Impact Assessment

The following table summarises the different impacts that are likely to arise from implementation of the option to add additional limit values for certain vehicle refinishing products and to shift some products from categories with higher VOC limits to categories with lower ones, as well as bringing some additional products within the Directive’s scope. The ratings are based on the information set out in the preceding chapters.

Table 70: Summary Impact Assessment

Stakeholder / Impact	Manufacturers	Professional Users	Consumers	Member State Authorities
Economic				
Capital/investment costs	0	0 or -/?	n/a	n/a
Operating costs	0	0	n/a	-/?
Product and raw material prices	0	0	0	n/a
Imports/competitiveness	0	0	n/a	n/a
Competition	0	0 or -/?	n/a	n/a
Entry costs	-/? or 0	0	n/a	n/a
Innovation/research	-/? or 0	0	n/a	n/a
Product performance	n/a	0 or -/? depending on product used	?	n/a
Monitoring/Surveillance costs	-	n/a	n/a	+/-
Social				
Employment	0	0	n/a	n/a
Health				
Environmental				
Cross media	0			
Waste and recycling	0			
Fuel consumption vehicle emissions	0			
Use of renewable/non-renewable resources	-/? or 0 (depending on energy consumption)			
Key: 0 = no impact +/- = uncertain impact positive or negative -/? = likely slightly negative impact but unquantifiable due to lack of data + = Positive impact ++ = Strongly positive impact - = Negative impact -- = Strongly negative impact				

Annex 5

5. Stricter VOC limit values for interior paints (Option 4)

5.1. Description of the Option and Background Information

5.1.1. Option 4

Option 4, as described in the interim report, is based on differentiating between interior and exterior applications of decorative paints, with VOC-limits for interior paints being set at more stringent levels than those for exterior paints.

Decorative coatings in Categories d), e) and f) (as classified in Directive 2004/42/EC) would be affected by the proposal, with the suggested limit for solvent-based interior paints in these Categories being set at 130 g/l. As solvent-based paints with such a low VOC content do not exist, they would be completely substituted by water-based products when implementing the option.

Table 71 sets out the existing VOC limits of the current Directive, showing current VOC limits and the limits that will come into force under the Directive in 2010 (Phase II). These values are compared the proposed new VOC limits for interior paints (bold letters), assumed to come into force in 2015.

Table 71: Existing and Proposed VOC Limits for Interior and Exterior Paints

EXISTING VOC LIMITS (as per Directive 2004/42/EC)			PROPOSED VOC LIMITS	
d) Interior/exterior trim and cladding paints for wood, metal or plastic substrate			d I) Interior trim and cladding paints for wood, metal or plastic substrates	
	Phase I (g/l) 1.1.2007	Phase II (g/l) 1.1.2010		Phase III (g/l) proposed by 1.1.2015
WB	150	130	WB	130
SB	400	300	SB	130
			d II) Exterior trim and cladding paints for wood, metal or plastic substrates	
				Phase III (g/l) as Phase II (g/l)
			WB	130
			SB	300
e) Interior/ exterior trim varnishes and woodstains, including opaque woodstains			e I) Interior trim varnishes and woodstains, including opaque woodstains	
	Phase I (g/l) 1.1.2007	Phase II (g/l) 1.1.2010		Phase III (g/l) proposed by 1.1.2015
WB	150	130	WB	130
SB	500	400	SB	130
			e II) Exterior trim varnishes and woodstains, including opaque woodstains	
				Phase III (g/l) as Phase II (g/l)
			WB	130
			SB	400
f) Interior/ exterior minimal build woodstains			f I) Interior minimal build woodstains	
	Phase I (g/l) 1.1.2007	Phase II (g/l) 1.1.2010		Phase III (g/l) proposed by 1.1.2015
WB	150	130	WB	130
SB	700	700	SB	130
			f II) Exterior minimal build woodstains	
				Phase III (g/l) as Phase II (g/l)
			WB	130
			SB	700

5.1.2. Background Information

After examination of the current limits in all categories covered by the Directive and detailed consultation with Member State authorities and with industry, the majority of limits in most categories were considered both appropriate and achievable as they stand.

However, it was noted by Sweden in particular that there is potential for significant reductions in VOC content if a distinction is made between internal and external use. The performance of decorative paints in an external environment is required to be higher and more durable due to their exposure to the elements and to obtain sufficient performance a higher solvent content is often required.

It was noted that legislation in the Netherlands, instead of actually banning solvent-based products from the market, actually requires substitution of high-VOC products in certain applications, specifically for professional painters in interior applications. Whilst the legislation in the Netherlands mainly aims at preventing (or at least reducing) the occupational disease 'Chronic Toxic Encephalopathy' (i.e. it is health-related legislation), distinguishing between internal and external use and setting a lower level limits for interior use has had the added effect of reducing the overall levels of VOCs in decorative paints.

5.1.3. Expected Impacts of the Proposed Option (General Introduction)

The intention of the proposed option is to require for interior coating the use of low VOC content or VOC-free decorative paints, substituting in particular high level VOC content decorative paints in the market. Indications are that applying this to specific categories of decorative paints will result in relevant reductions in VOC emissions.

Consultation with industry stakeholders, in particular with CEPE and member state authorities, has indicated some concerns regarding the implementation of this option. Concerns over the enforcement of the proposed regulation and the fact that both professional users and consumers may still use the higher level VOC containing paints could reduce expected benefits. CEPE has also pointed to the fact that the market would become more complicated with a wider selection of products being required as some dual use products would no longer be viable. CEPE underlines that such an increase in the complexity of the product portfolio will result in increased costs to the manufacturers as they are required to develop new products. CEPE also noted that the industry is suffering from a 15 % decrease in the decorative paint market during the recent recession.

CEPE has indicated that the option would affect, to varying degrees, approximately 4,000 of 8,000 producers who are supplying at least some products that would become non-compliant after the limits within the option came into force. Information received from an Eastern European company estimated that only around 5 % of its current production volumes were currently compliant with the proposed limits. However, compliant products are available indicating that there are no technical barriers to their production and performance.

5.2. VOC and ozone reduction potential

5.2.1. Availability of data

Background data for the estimation of the reduction potential of the proposal was provided by CEPE. The data covers information on quantities of paints consumed, VOC content and resulting VOC emissions for 2003 and 2006.

The data provided by CEPE includes market information for the Member States of EU-15. Furthermore, complete datasets for four additional countries have been made available by CEPE. Data on paints consumed and VOC emissions for eight additional EU Member States plus Croatia and Turkey had to be estimated separately. For these estimations data of EU-15 have been assumed to be valid for the additional countries, like average VOC content values, density factors and the share of matt and glossy paints for water-based and solvent-based products for ‘interior wall and ceiling paints’.

The estimation of data for the additional ten countries was accomplished using national Gross Domestic Product (GDP) data provided by EuroStat database. Data from CEPE were aggregated resulting in figures for ‘EU-19’. Afterwards the result of 'EU-19' was extrapolated to EU-27+2 data, applying the proportion of GDP for the EU-27+2 countries relative to the GDP of the given EU-15 Member States plus Cyprus, Hungary, Poland and Slovakia.

The resulting totals in paint consumption and VOC emissions for EU-27+2 have been compared to the given totals for the 19 countries. The difference between these totals was distributed among the additional ten countries using the national shares of GDP in the total GDP of the EU-27+2. With these estimations the total amount of paints increased from 3.76 kt to 4.02 kt for 2006.

The resulting national market data for decorative paints was used to estimate national and EU-wide reduction potentials of the proposed option 4.

5.2.2. Approach of projection for scenarios in 2010, 2015 and 2020

For the assessment of the impacts of the reduction in VOC emissions on economic, social and environmental areas and as one part of the cost benefit analysis, different scenarios with respect to future years have been examined. These future years were agreed to be 2010, 2015 and 2020.

In order to allow for these scenarios, data provided by CEPE for 2003 and 2006 were extrapolated into these future years. The factor used for the extrapolation was assumed to be an annually constant growth rate based on the given development between 2003 and 2006. The formula of the so-called compound annual growth rate (CAGR) enables the estimation of a constant annual growth rate for given initial and final values.

The compound annual growth rate was applied for the projection of sales of paints in 2010, 2015 and 2020. The growth rate has only been estimated for the development of the total market of EU-15 plus Malta and Cyprus in order to provide a standardised tool to estimate data for the future scenarios for the EU-15 and all additional countries.

5.2.3. Description of scenarios and estimation of reduction potentials

The reduction potential for each country of the EU-27+2 was estimated through comparison of the VOC emissions from a "business-as-usual" (BAU) scenario where no regulatory changes will come into play and a DECOPAINT-NEW scenario where the above mentioned differentiation between interior and exterior applications of paints will be introduced along with new VOC limit values for interior applications. The scenarios are described in more detail in this chapter.

5.2.3.1. Business as usual scenario (BAU)

The BAU scenario represents the case where no new regulatory measures have been introduced to the market and where the only changes with respect to the years 2003 and 2006 can be found in the amount of paints sold and the VOC emissions resulting from these sales.

For each of the future years 2010, 2015 and 2020 as BAU scenario has been estimated applying the above described CAGR. The values for VOC contents of the different product groups have been adjusted to the VOC limit values as they will be implemented in 2010 according to Directive 2004/42. These adjustments do not reflect new regulatory interventions as these changes in VOC contents refer to regulatory measures that already have introduced to the market.

5.2.3.2. DECOPAINT-NEW scenario for option 4

The estimations of the reduction potential of new VOC limit values for interior applications of paints requires a general distinction between interior and exterior utilisation of paints. In consultation with CEPE, the shares of interior and exterior applications for the concerned categories (d), (e) and (f) were assumed to be as summarised in Table 72.

Table 72: Option 4 – Separation of interior and exterior applications of paints for categories (d), (e) and (f)

Category		%-share
Interior/exterior trim and cladding paints for wood and metal (cat. d)	Interior	50%
	Exterior	50%
Interior/exterior trim varnishes and woodstains, including opaque woodstains (cat. e)	Interior	30%
	Exterior	70%
Interior and exterior minimal build woodstains (cat. f)	Interior	10%
	Exterior	90%

The estimations of scenarios for the new VOC limit values with respect to the site of application were accomplished for the years 2015 and 2020. An estimation of a reduction scenario for 2010 has not been carried out as the time period for manufacturers for implementing the new limits was assumed to be too short. The market data on consumption of paints for the future scenarios has been estimated as shown for the BAU scenario.

The introduction of a new limit of 130g/l for interior paints was assumed to lead to a complete substitution of solvent-based paints for interior use. Furthermore, it was assumed that the consumption of solvent-based paints will completely be replaced by an increase in consumption of water-based paints. For exterior applications of paints it is assumed that the existing limits of Directive 2004/42/EC will remain valid.

The following table summarises the reduction potentials resulting from an implementation of different VOC limit values for interior and exterior paints. The results are shown for each country of EU-27, for the total of EU-27 and for the accession countries Croatia and Turkey.[59] The table presents a reduction potential for EU-27 of 26.1 kt for 2015 and 25.4 kt for 2020. The decrease in these amounts can be referred to decreasing markets for solvent-based products.

[59] For the estimations of the reduction potential an emission factor of 0.95 was applied. Thus, not all of the VOC content is emitted but 5% of the VOC are assumed to remain in the container and are not released into the air. This factor is based on an agreement of experts during the compilation of the German emission inventory.

Table 73: Reduction potentials for Option 4 per country, in kt

Country	2015	2020
	kt	kt
Austria	0.20	0.19
Belgium	0.50	0.49
Bulgaria	0.06	0.06
Cyprus	0.73	0.71
Czech Republic	0.27	0.26
Denmark	0.26	0.25
Estonia	0.03	0.03
Finland	0.21	0.20
France	1.66	1.60
Germany	2.95	2.85
Greece	0.66	0.63
Hungary	0.73	0.71
Ireland	0.41	0.39
Italy	3.44	3.32
Latvia	0.04	0.03
Lithuania	0.06	0.05
Luxemburg	0.00	0.00
Malta	0.01	0.01
Netherlands	1.16	1.14
Poland	1.93	1.85
Portugal	0.29	0.28
Romania	0.21	0.20
Spain	3.59	3.49
Sweden	1.09	1.07
UK	5.11	4.98
Slovenia	0.08	0.07
Slovakia	0.43	0.51
EU-27	26.09	25.38
Croatia	0.10	0.10
Turkey	0.94	0.92

5.3. Economic Impacts

5.3.1. Impact on Public Authorities and Public Spending

Monitoring and administrative cost

Member States varied in their responses to consultation when asked whether option 4 would be likely to result in increased monitoring and surveillance activities and related costs. Estonia, Cyprus and Bulgaria felt that there would be an increase in surveillance requirements. Additionally, Cyprus pointed to the fact that there would be a requirement for awareness raising activities, as well as training of inspectors. Romania suggests that changes to surveillance and monitoring activities associated with the option "will involve high cost because of the different processes of production, packaging and labelling."

At the stakeholder workshop held to discuss the preliminary outcomes of the consultation exercise, the United Kingdom stressed the fact that it would be difficult to police the implementation of this option, given the fact that decorative paints subject to both the interior and exterior limits will still be available and, ultimately, it is the responsibility of the user with regard to which type of paint is used inside and outside.

Member States such as Ireland, Spain and Greece on the other hand, indicated that they did not feel there would be a substantial, if any, increase in surveillance activities and costs. This may be because the products which fall under this option are already covered by the Directive and will therefore be subject to monitoring and surveillance activities anyway, and any new information required/checking that may need to be carried out to cater from the division between interior and exterior paints could be done within the context of these normal surveillance activities.

5.3.2. Investment

5.3.2.1. Capital investment incurred due to new equipment, reformulation, etc,

CEPE stressed that they anticipate significant investment would be required if the option were to be implemented, particularly if it were implemented within a relatively short timescale. The option creates an additional category for limits above the existing Directive which increases the product range and complexity and will require additional storage and working capital.

It has been difficult for stakeholders to provide any substantiated estimates of the costs that might be involved. One company from Eastern Europe with a production value of approximately €5 million per annum estimated the total cost of moving to compliant products would be €1.25 million. However without a break down for this figure, it is difficult for the study to comment on it. Relabelling costs as a result of the option and the requirement to specify whether products are for interior or exterior use have been estimated by CEPE as being at approximately €150 per stock keeping unit.

5.3.2.2. Stranded assets

Consultation highlighted the fact that investments have already been made to meet with the current requirements of the existing Directive (e.g. in order to make high-solid alkyds) and the costs of these investments might be largely wasted. However, the study has not received any information regarding quantified costs; the common response to this question was that the information is commercially sensitive and therefore could not be provided.

5.3.3. Impact on Competitiveness and Trade in Relation to Trade with Non-EU Countries

5.3.3.1. Import penetration and Competitiveness of EU companies in external markets and exports

CEPE has informed that imports of decorative paints into the European Union from third countries are not significant and that the introduction of the option is unlikely to have any significant impact in this respect. No information has been provided that might suggest that the option would affect the costs of the EU industry to such a degree that it might result in external companies from third countries entering the EU market.

5.3.4. Impact on Functioning of the Internal Market and Competition

5.3.4.1. Number of firms (entry/exit rates)

As mentioned above, CEPE estimates that currently approximately 4,000 companies are supplying at least some products that will become non-compliant and states that 95% of these companies are SMEs. Whilst not indicating the degree to which it might happen, CEPE has indicated that current market conditions may mean that the extra costs arising from this option could result in firms leaving the industry.

CEPE also suggests that the segmentation of the market and the resulting increased product range would increase start-up costs for new companies by approximately 2.5 to 5 %, due to higher development costs and inventory requirements. This may well apply to existing companies who are looking to supply a larger range of products, but such a segmentation of the market may also provide opportunities for smaller companies who are looking to supply niche parts of the market.

5.3.4.2. Profitability of firms

Whilst consultation has not revealed any quantitative figures, stakeholders have indicated that the option would have a negative impact on profitability due to increases in organisational costs.

5.3.5. Impact on Innovation and Research

No specific effects have been identified with respect to innovation and research, although it has been noted by consultees that the option would divert resources away from other potential projects as companies strive to meet the technological requirements. In this sense, there could be a clear opportunity cost in terms of the need to allocate finance to developing compliant products. It is unclear at this stage what quantity of funding firms that are currently producing non-compliant products would have to allocate to bringing those products into line with the proposed legislation.

Information is lacking on the number of non-compliant products that are currently being placed on the market, as is information regarding the number of companies which sell both compliant and non-compliant products.

For the latter, the proposed option might simply be shifting production (albeit with associated increased costs) from non-compliant to compliant products without any implication for additional expenditure on research and development to bring new products to the market.

5.3.6. Impact on Operating Costs and Conduct of Businesses (SMEs)

5.3.6.1. Additional operating costs (e.g. labelling)

As indicated above, CEPE has estimated the average cost of re-labelling the products affected by this option as being in the region of €150/SKU. However, the costs of such label changes could be minimised by harmonising these timeline of new requirements with those introduced by the Classification, Labelling and Packaging Regulation, due to come into force for mixtures in June 2015.

Otherwise it has been difficult to obtain concrete information on costs associated with implementing the option. Whilst the option introduces stricter limits on VOC content for decorative paints used in interior applications, it appears that the option would not increase costs to manufacturers for testing products to ensure compliance since they are already subject to certain limits under the current Directive.

5.3.6.2. Cost and availability of essential inputs

Consultation provided no indication that implementing the option would have any negative consequences in terms of the availability and/or cost of essential inputs to making water-based decorative paints. Consultees were unable to provide any information on the relative costs of inputs for both solvent-based and water-based paints (as a result of commercial confidentiality), so it is not possible to provide a clear indication of whether or not raw material costs would increase or decrease as a result of the option.

5.3.6.3. Impacts up and down the supply chain

Apart from the organisational aspects identified with the segmentation of the market, the main impact identified by consultees in the overall supply chain of decorative paints was the overall change in demand for solvent-based alkyd resins. The demand for these resins will inevitably reduce since the limit proposed for interior paints would effectively represent a substitution of solvent-based paints for use in interior applications. CEPE has estimated that the reduction in demand for these resins could be as much as 50 % (or more) of the current demand. However, there would also be an increase in demand for water-based resins due to the increase in demand for water-based decorative paints for use in interior applications.

5.3.7. Impact on End-Users (consumers and professional end-users)

5.3.7.1. Price of product and investment in equipment

CEPE estimates that the prices consumers and professionals will have to pay for their decorative paints are likely to increase by between 5 % and 10 % under this option. This would stem from the organisational costs and labelling costs resulting from segmentation of the market. The study team has been unable to verify these figures independently and it is unclear at this stage how these amounts were derived.

No new equipment would be required by professional painters since the equipment used has a finite usable life and replacements required for water-based coatings could be obtained without any significant costs.

5.3.7.2. Productivity of professional end-users (labour time, re-application) and Quality/availability/consumer choice

The Cefic SRM sector group expressed the view that not only would the option introduce complexity in product marketing where it did not exist before, but that the proposal for category d), in particular, would result in longer drying times being required, softer films, reduced mark resistance and impaired workability.

CEPE has highlighted the fact that using water-based coatings in low temperatures and high relative humidity is problematic, particularly where the ambient temperature is below 0° C and is of the view that the quality of the finish from water-based paints is lower in terms of gloss and reflected image clarity. However, long term experience in e.g. the Netherlands shows that it is mainly *initial* gloss of water-based coatings that is lower. With respect to gloss retention as well as yellowing, water-based coatings (if based on acrylates or PU-acrylates, as in most of the cases) perform better than solvent-based alkyds. Consultation response from one company suggested water-based alternatives are often not as durable and, as a result, application would need to be repeated more often. The consultee suggested that this could possibly lead to an overall increase in VOC emissions compared to the expected VOC reduction, although the study has not been able to verify this one way or another.

However, experience in the Netherlands where generally stricter limits than those currently in force in the Directive have been imposed has been largely successful (albeit based on 'use' rather than on the placing of products, and utilising a different definition of VOCs but which still effectively substitutes the use of solvent-based paints and coatings in indoor applications). The current performance of water-based paints for interior use in the Netherlands is considered satisfactory by manufacturers as well as by end users. In most ´typical indoor´ cases with higher temperatures and relatively low humidity (and in fact during warm and dry summer conditions in most EU countries also in outdoor applications), users of water-based coatings experience *shorter* drying times instead of longer drying times. This enables the application of both primer and topcoat on one day, instead of on two subsequent days. In addition, windows and doors can be closed sooner when water-based coatings are used.

5.3.8. Impacts on Specific Countries/Regions

It would appear that the main impact that may differ between different Member States relates to the overall performance of decorative paints and their drying times. As illustrated elsewhere, consultation with industry stakeholders indicated that there was a link between ambient temperature and humidity and the drying times and performance of paints. Consequently, southern Member States might be expected to be less impacted by the option in these two issues, and those Member States with colder and more humid climates would be more likely to experience issues in terms of the length of time it takes paint to dry as well as potentially the paint's performance.

5.4. Social Impacts

5.4.1. Health impacts

The implementation of the option will result in a reduction of VOC emissions which may result in a marginal reduction of average ground level ozone concentration in EU-27, Croatia and Turkey.

The modelled effects on human health due to this change in air quality are shown in the following table where average meteorological conditions and the 2020 reference emission scenario have been used. These figures take into account that the VOC reductions within EU-27+2 will also change the exposure of population in neighbouring countries (total Europe, EMEP grid). By considering only the impacts within EU-27 and Croatia/Turkey, the externalities will decrease to €4.0 million for 2015 and €3.89 million for 2020.

Table 74: Health benefits due to reduction of VOC emissions and related to ground level ozone reduction

		2015	2020
Reduced external costs	[€_00][60]	5,179,209	5,035,496
Mortality	YOLL	37.045	36.017
Morbitity RHA, ages over 65	cases	20.97	20.39
MDR, ages 18-64	days	83,698	81,376
RMU by adults	cases	30,404	29,561
RHA = cases of restricted hospital admissions; MDR = restricted activity days RMU = cases of respiratory medication use, YOLL = Years of Life Lost			

5.4.2. Impact on Employment

Any impacts on employment are likely to vary significantly from country to country according to different cultural preferences, e.g. in some countries it is common practice to paint external facades of houses (Scandinavia) whereas in others (the Netherlands) it is rare. Consequently, it is uncertain how much of companies' production would be affected by the introduction of the option; thus, it is not possible to predict what the impacts may be on company profitability and consequently on employment. Assuming that some companies will exit the interior paint market, there will likely be some negative impact on employment, but it is not possible with current information to predict the scale of such effects.

5.4.3. Impacts in the Workplace

Impacts on specific professions

Since water-based paints take longer to dry at low temperatures and/or high humidity, professional painters and consumers using interior paints may face longer drying times in some cases. Whilst this might cause a small inconvenience for consumers, it will mean that professional painters may have to allocate longer periods to completing jobs, resulting in a reduction in profitability where they are forced to wait for paints to dry in one part of a job prior to moving on to the next stage. As stated above however, water-based coatings may dry even *faster* than solvent borne coatings in many instances.

5.5. Environmental Impacts

5.5.1. Changes in the Ground Level Ozone Concentration

The reduction of VOC emissions may reduce the ground level ozone concentration in Europe. The correlation between the VOC emission reduction and ozone

[60] The monetary values reported in this table are expressed in Euro on the basis of the value of the Euro in the year 2000. The estimation of the monetary values expressed in Euros of 2000 enables a comparison of the monetary values estimated for 2015 and 2020.

concentration is a non-linear and it is influenced by a number of parameters, e.g. relevant impact on the processes have the NO_2 background concentrations and the meteorological conditions. The region or country where the VOC emissions are reduced have as well a relevant impact on the European wide changes in the ozone concentration.

The impacts of option 4 on the ground level ozone concentrations are shown in the following table. For the calculations average meteorological conditions and the reference emission scenario for 2020 have been assumed.

Table 75: Impact of option 4 on the average ground level ozone concentration within EU-27 + Croatia and Turkey.

	average O3 concentration [ppb]	
	changes in [ppb]	percental changes
2015	0.003	0.010%
2020	0.003	0.009%

5.5.2. Impacts on Field Crops

The ozone reduction of the option may contribute to prevent part of the production losses due to crop damage. The benefit of the VOC reduction has been quantified for 2015 to €2.77 million and to €2.69 million for 2020.

5.5.3. Cross-media Effects

There is a possibility that this option would result in increased paint waste going to wastewater systems under this option, if it results in consumers washing brushes in the sink with water after using water-based paints. One consultee has identified this as a potential problem, as people would move away from using small amounts of solvents to clean brushes used to apply the current solvent-based paints. However, it is difficult to verify this. It is also possible that the option could reduce harmful emissions to wastewater systems by reducing the extent to which consumers clean brushes coated with higher VOC paints with solvents and then wash these down the sink.

5.5.4. Waste and Recycling

CEPE has suggested that the market segmentation that will come about as a result of the option will mean that different products will be used on interiors and exteriors, leading to a higher number of cans of paint being consumed. By way of example, in order to paint a house's main front door, it will be necessary to use one tin of paint for the inside face of the door and a second tin for the outside face of the door. Depending on the amount of paint used and the compatibility of the size of the tins, there could be waste paint left over in both, as well as a second tin to dispose of.

5.5.5. Fuel Consumption and Vehicle Emissions

The segmentation of the market referred to earlier on by CEPE could lead to an increase in vehicle movements in the supply chain, to provide the raw materials for manufacture of a greater range of products and for the distribution of a wider range of products within the supply chain. Due to the unavailability of information, it is impossible to assess the magnitude of this effect.

5.5.6. Use of Renewable/Non-renewable Resources

Manufacturers have highlighted the fact that alkyds used in the production of solvent-based products contain significant renewable content, whereas water-based products often use other resins (e.g. acrylics) with no or a much lower renewable content (although the precise relative extent of use of renewable content in each type of product has not been provided). Although water-based acrylics or PU-acrylics (dispersions) are most popular, water-based alkyds (emulsions) are available as well. However, current market shares of water-based acrylics vs. water-based alkyds are not known.

5.5.7. Impacts on Field Crops

The ozone reduction of the option may contribute to prevent part of the production losses due to crop damage. The benefit of the VOC reduction has been quantified for 2015 to €2.58 million and to €2.42 million for 2020.

5.6. Summary Impact Assessment

Table 76 summarises the main impacts that are likely to arise from implementation of the option to distinguish between indoor and outdoor applications of decorative paints. The ratings are based on the information set out in the preceding chapters.

Table 76: Summary Impact Assessment, proposed interior and exterior VOC limits

Stakeholder Impact	Manufacturers	Professional Users	Consumers	Member State Authorities
Economic				
Capital/investment costs	--/?	0	0	n/a
Operating costs	Unknown	-	n/a	-/?
Product and raw material prices	--	-	-	n/a
Imports/competitiveness	0	0	n/a	n/a
Competition	-/?	0	n/a	n/a
Entry costs	-/?	0	n/a	n/a
Labelling costs	0	n/a	n/a	n/a
Innovation/research	-/?	n/a	n/a	n/a
Supply chain impacts	+/-	n/a	n/a	n/a
Product performance	n/a	-/?	0	n/a
Monitoring/Surveillance costs	-	n/a	n/a	-/?

Social				
Employment	-/?	0	n/a	n/a
Health		+	+	
Environmental				
Cross media	+/-			
Waste and recycling	-/?			
Fuel consumption vehicle emissions	-/?			
Use of renewable/non-renewable resources	-/?			

Key:
0 = no impact
+/- = uncertain impact positive or negative
-/? = likely slightly negative impact but unquantifiable due to lack of data
+ = Positive impact
++ = Strongly positive impact
- = Negative impact
-- = Strongly negative impact

Annex 6

6. Information collection on options for extention of the current scope

6.1. Aims of information collection

Information collection related to products for a possible scope extension of Directive 2004/42/EC was realised to obtain the following information:

1. Data on VOC contained and emitted from products in a recent base year, if possible for each Member State of EU-27, Croatia and Turkey
2. Detailed data of existing product categories of the same recent base year, if possible for each Member State of EU-27, Croatia and Turkey
3. Information on technical feasibility of VOC reduction
4. Information on restrictions for VOC reduction (user-friendlyness, cultural habits, etc.)

6.2. Information on existing VOC limits for possible extension of the scope

EU-27 Member States have been asked by the project team by means of a questionnaire: “Do national VOC-limits for *other* products exist in your country? (e.g. for adhesives, cosmetics, cleaners, building-products – please specify)”

Answers were given by 20 Member States. 1 Member State (AT) reported about existing VOC limits for additional products and 19 Member States (BE, BG, CY, CZ, DK, EE, EL, ES, FI, IE, LT, LV, MT, NL, RO, SE, SI, SK, UK) reported, they had no VOC limits for other products in their country. Five Member States of those reporting no other VOC limits, reported voluntary or partly limitations of the VOC content for other products (CZ, DK, FI, NL, SE).

Table 77 gives an overview on the answers of Member States regarding existing VOC limits for other products than those, already covered by the scope.

Table 77: Existing VOC limits for other products reported by Member States

Building products (ban or limits on certain VOCs)	Adhesives (ban or limits on certain VOCs)	Underwater coatings (ban or limits on certain VOCs)	Other limitation of VOC content (voluntary, partly limitation)	No additional VOC limit values
AT	AT	AT	CZ, DK, FI, NL, SE	BE, BG, CY, CZ, DK, EE, EL, ES, FI, IE, LT, LV, MT, NL, RO, SE, SI, SK, UK

6.2.1. Description of existing VOC limits for other products

6.2.1.1. Building products, adhesives and waterproof coatings

Austria reports, that “the Austrian solvent regulation (BGBl. 872/1995) bans the use of chlorinated compounds in building products, adhesives and underwater coatings, and limits the content of aromatic hydrocarbons in these products. There are no limits for the total VOC content” [AT Quest, 2008].

The Czech Republic states, that they do “not have the legislation limits for other products” but that “some definitions of the Directive 2004/42/EC, however, are now defined more broadly” [CZ Quest, 2008].

Denmark reports: “For the purpose of workers protection, a system (MAL-code system) is set up based on the content of VOC and the hazard to humans” [DK Quest, 2008].

In Finland, some companies have a voluntary classification system [FI Quest, 2008] which aims at consumer protection and is used “for example for building products, for tiling products, adhesives and for mastics, fillers and screeds” [FI Quest, 2008].

In the Netherlands, VOC limits exist for other products, but not when ‘placing on the market’ but for all adhesives used by professionals (carpet layers and parquet layers): VOC content needs to be < 5 g/l, meaning a prescription of VOC-free adhesives like water-based, reactive or hotmelt. [NL COT Report, 2008]

In Sweden VOC limits are applied for several products on a voluntary basis: “In the Nordic Ecolabelling System for a number of products requirements on content and use of organic solvents and VOC.” [SE Quest, 2008] Most of these requirements refer to VOC emissions after product application (indoor air quality limits), similar to the system established in Germany called ‘Emicode’ classification (http://www.emicode-produkte.de).

6.3. Member State proposals for extension of the scope

The Member States have been asked: “Do you have proposals for an extension of the scope?”

Answers were given by 22 Member States. 12 Member States (AT, BE, BG, CY, CZ, DK, EL, LT, LV, MT, NL, SE) made proposals and 10 Member States (EE, ES, FI, HU, IE, PL, RO, SI, SK, UK) did not propose an extension of the scope.

Table 78 gives an overview on the answers of Member States regarding proposals for an extension of the scope.

Table 78: Proposals of Member States for an extension of the scope

Product type	Member State
All products placed on the marked	CY, MT
Other proposal: Reduction of VOC limit values	DK, SE
Other deco products in housing situations for metal, wood (furniture) etc	BE, BG, CZ, EL
Vintage (historic) vehicles	BE
Vehicle trailer	SE
Marine coatings	EL
Heavy duty anticorrosive/ Protective coatings	AT, BE
Putties and daubs	LT
Road marking materials	AT
Aerosols	AT, BE, LT
Cosmetics	AT, BE, NL
Cleaners and household products	AT, BE, NL
Metal/hard surface cleaning products/degreaser	SE
Car and boat care products	SE
Certain application areas using printing inks	SE
Adhesives	AT
No proposal	EE, ES, FI, HU, IE, PL, RO, SI, SK, UK

One Member State (UK) commented that motorcycles are not explicitly in the scope of Directive 2004/42/EC, as the definition of 'vehicle' in annex 1 (2) of the directive refers to vehicles defined by Directive 70/156/EEC, which does not cover motorcycles. Meanwhile, Directive 70/156/EEC has been replaced by Directive 2007/46/EC. The revised directive neither includes motor cycles.

Statistical data on paint use for motor cycles is not available. However, it may be assumed that paint products used on motor cycles – mostly by the consumer – will be aerosol-type vehicle refinish paints in most cases. Thus, these products are already in the scope of Directive 2004/42/EC under category (e) 'Special finishes', with a VOC limit of 840 g/l.

6.3.1. Description of the proposals

6.3.1.1. All products placed on the market

Two Member States (CY, MT) propose to extend "the scope of the Directive (annex I) […] to cover all products placed on the market and not only those applied to buildings" [CY Quest, 2008] and to cover "all types of paints irrespective of the use" [MT Quest, 2008].

6.3.1.2. Other deco products used in the context of 'buildings'

Due to the limitation of the scope in annex II A to paints and varnishes used for 'buildings' and their parts, four MS (BE, BG, CZ, EL) proposed to extend the scope to other decorative paint products used in the context of 'buildings'.

Belgium proposes to cover "all the products used in housing situations and particularly to furniture coatings". Furthermore they "strongly recommend the limitation of individual licenses provided for in Article 3(3) to only officially classified buildings". [BE Quest, 2008].

The Czech Republic proposes to extent the scope to "coatings for wood, and regardless of whether we use it on the buildings, windows, furniture, etc" [CZ Quest, 2008]. Greece as well demands an extension to "wood and furniture finishing" [EL Quest, 2008].

Bulgaria proposes to extend the scope by changing the definition of 'building' and demands to compulsory include into the definition "moveable furniture and also include doors, radiators, bath-tubs, tiles, etc" [BG Quest, 2008].

Lithuania mentions 'putty' or 'daub' as "another candidate" for an extension of the scope [LT Quest, 2008].

6.3.1.3. Protective coatings / heavy duty anti-corrosives

Two Member States (AT, BE) propose to cover protective coatings. Austria mentions especially "heavy duty anticorrosives" [AT Quest, 2008] which could be covered. Belgium as well proposes the inclusion of protective coatings, and as well provides suggestions for an implementation.

For the implementation, Belgium "would prevent the distinction between '*in shop*' and '*on site*' application into a same category of product. Such distinction will lead to overlaps between 1999/13/EC solvent reporting and product directives" [BE Quest, 2008]. Belgium proposes "to keep out of the scope the '*only on site*' application products, and if really necessary for some specific activities introduce a derogation process (as provided for article 3(2) for decopaints)" [BE Quest, 2008].

By 'only on site' application products in this coherence Belgium describes products, which are produced and processed by the same manufacturer and where the products will not enter the free markets. [BE Pers, 2008]

6.3.1.4. Aerosols

Three Member States (AT, BE, LT) propose an extension of the scope to aerosols.

Lithuania states, that "the aerosol paints and varnishes could be covered by the Directive 2004/42/EC" [LT Quest, 2008]. Belgium proposes to include "spray products" product-spanning (varnishes, cosmetics, etc), subject to its evaluated meaningfulness [BE Quest, 2008; BE Pers, 2008] and Austria would also "support inclusion of aerosols" [AT Quest, 2008].

6.3.1.5. Cosmetics

Three Member States (AT, BE, NL) propose to include 'cosmetics' in the scope. The Netherlands refer to "the conclusions of the IVAM report on VOC and products" [NL Quest, 2008] which also covers – among others - cosmetics. Austria and Belgium mention "cosmetics" in general. [AT Quest, 2008] [BE Quest, 2008]

6.3.1.6. Cleaner and household products

Three Member States (AT, BE, NL) propose the inclusion of cleaner and household products; they do this togehter with mentioning cosmetics (2.3.1.3). [AT Quest, 2008] [BE Quest, 2008] [NL Quest, 2008]

6.3.1.7. Metal cleaning products, degreaser, marine coatings, printing inks, adhesives, road marking, putty and daubs,

Sweden proposes to extend the scope to "metal and other hard surface cleaning products/degreasers", "car and boat care products" and as well to "certain application areas using printing inks" [SE Quest, 2008].

Sweden also states, that "the rules for vehicle trailers must be revised as well" [SE Quest, 2008]. They stress that, "it has to be clear that refinishing of trailers is also within the scope of the Decopaint Directive". Sweden argues that the definition of "coating of trailers" and "refinishing of vehicles" in Directive 1999/13/EC may lead to the interpretation that the *refinishing* of trailers is - like the original coating of trailers - covered under the Directive 1999/13/EC. To this misunderstanding might as well contribute the definition of "vehicle" in Directive 70/156/EC Directive 1999/13/EC refers to. It would not be perfectly clear, whether trailers are vehicles and therewith covered by the definition of "vehicle refinishing" of annex II B of Directive 2004/42/EC. [SE Pers, 2008]

Austria "could support inclusion of […] adhesives […] [and] road marking materials" [AT Quest, 2008].

Lithuania proposes to include "putty" and "daubs" [LT Quest, 2008] and Greece nominates "marine coatings" [EL Quest, 2008].

Belgium proposes to extend the scope to vintage vehicle by deletion of the exception in Article 3(3) "because low VOC alternatives […] exist (with a same final effect)" [BE Quest, 2008].

Annex 7

7. Wood Coatings – Impact Assessment (Option 8)

7.1. Description of Options and Background Information

7.1.1. Option

Option 8 considers extending the scope of Directive 2004/42/EC to cover wood coating activities that are presently not covered by Directive 2004/42/EC or Directive 1999/13/EC. Consultation was carried out with stakeholders from industry associations, focusing on the potential impacts of setting VOC limits of 300g/l by 2011 and 100g/l by 2014 on the furniture and musical instrument sectors.

7.1.2. Background Information

Some Member States have applied VOC content restrictions to coating products used by installations which are below the 15 kt threshold applicable to Directive 1999/13/EC, while others have not. For example in the Netherlands, the timber industry has had to apply wood coatings with a maximum VOC limit of 150g/l since 2004, resulting in the fact that only water-based coatings can be used. The experience within the Netherlands has been positive and application of additional VOC limits on wood coatings in installations not currently in the scope of Directive 1999/13/EC (i.e. below the 15 kt threshold) appears feasible. SHR, the main Dutch timber research institute has concluded that water-based coatings can perform at least as well as solvent-based coatings, although there are wide variations in quality for both types. The process selected for drying products coated with water-based coatings (either using drying equipment which results in a shorter production cycle, or making use of longer drying times) appears to be immaterial in terms of the quality of the finished product, if appropriate conditions and drying times for each are selected.

Consideration is given in this impact assessment to the effects of introducing the suggested limits with specific reference to the furniture and musical instrument sectors, which are significantly different to the timber industry producing wood coated products for use in buildings. Timber which has been coated with various paints or varnishes is clearly used in a whole range of other applications, but the limited time available for this impact assessment has required the study to focus on these two sectors in particular.

7.1.3. Expected Impacts of the Proposed Option (General Introduction)

Setting VOC limits of 300g/l and 100g/l will effectively place a ban on the use of solvent-based wood coating products for use in the two sectors under consideration in this impact assessment. This will then limit choice to water-based products and other more recently emerging low-VOC technologies such as:

- UV-drying coatings (including water-based variants);
- 2-1 polyurethanes; and
- Powder coatings.

The musical instrument and furniture sectors are characterised by the high quality finishes required for a number of products and are thus well suited for this assessment. The interim report pointed to the fact that, for the furniture industry, the feasibility of water-based coatings may be less than for the timber-for-buildings sector due to the high performance required in terms of gloss, scratch resistance, chemical resistance and the use of specific wood types (e.g. oak). Similarly in the musical instrument sector, coatings for wooden instruments such as the violin family (violas, violins, cellos, double bass, flutes etc.) require high performance across the same categories as furniture, but also sweat resistance, resistance to wear through rubbing by hands and tonal qualities.

The performance of water-based varnishes in these areas has been questioned in a number of applications by experts (CEPE, national trade associations, CEFIC solvent Resin Manufacturers sector group, product manufacturers) in both sectors during the consultation process for this impact assessment.

7.2. VOC and ozone reduction potential

7.2.1. Availability of data

Background data for the estimation of the reduction potential of the initially presented proposal of new VOC limit products of the furniture and musical instrument sector was provided by CEPE as base for the development of the Thematic Strategy in frame of the CAFE process. The data includes information on the total consumption of products and the share of different product types of this total for 18 countries of the EU-27 Member States. Furthermore, current VOC limit values have been provided which allow for an estimation of the total VOC emission for these countries. The estimations are given for 2005, 2010, 2015 and 2020.

In order to extend the scope of the estimations to cover all of the EU-27 Member States plus Croatia and Turkey, the total consumption figures were extrapolated using the difference in total GDP for the covered countries and the EU-27+2. The resulting additional amount in consumption was distributed among countries applying the national shares of GDP. Furthermore, the shares of the different product types within the total consumption were used to estimate an average market share of each product type. These average market shares were used for all countries where no data was provided. All these estimations allowed for an estimation of the national total VOC emissions and the total EU-27+2 VOC emissions.

In discussions with CEPE, it was mentioned that the data provided by IIASA included installations that were already covered by Directive 1999/13/EC (Solvent Emissions Directive, 'SED') and national legislations. To estimate the share of activities already covered by these regulations and to find out the amount of activities to be analysed in this option, the data IIASA provided for the estimations were compared to data from the German Emissions Inventory. The data from the German inventory covers wood coatings for construction purposes, carpentries, interior fittings and furniture.

Additionally, data on the wood coatings used for boat building was available, but it was decided not to include boat coating in option 8 but as separate option 15 (see chapter 18 on page 184).

For the further estimation of the reduction potential of option 8, assumptions on the percentage of products already covered by the Solvent Emissions Directive and national legislations had to be made by the project team. These assumptions are summarised in the following table. For the German inventory, expert judgements had been made by producers on the share of wood coatings for furniture and interior fittings already covered by the Solvents Emissions Directive, concluding in a 50:50-percent-share. This share was taken over.

Table 79: Wood coating products in Germany and assumptions of shares covered by SED and Directive 2004/42/EC

	Total wood coatings (in tonnes)	Already covered by SED	Already covered by 2004/42/EC	Not covered and not to be included in option 8	To be covered and included in option 8	Wood coatings not included in option 8 (in tonnes)	Wood coatings to be included in option 8 (in tonnes)
Other construction coatings	18,674		100%			18,674	
Furniture	52,028	50%			50%	26,014	26,014
Carpentries / interior fittings	36,101		50%		50%	18,050	18,050
Boat building	7,738			100%		7,738	
Total	114,541					70,476	44,064
	100%					61.52%	38.48 %

[German VOC Emissions Inventory, 2009]

As presented in the table, the assumptions lead to an amount of about 62% of the total wood coating products already covered by existing regulations or not included in the scope of option 8. Consequently, about 38% of all wood coating products are not yet covered by legislation and were analysed in this option.

This figure has been assumed to be valid for all of the EU-27 Member States plus Croatia and Turkey and has been applied to adjust stated figures on total sector activity.

7.2.2. Description of scenarios and estimation of reduction potentials

The two scenarios of an implementation of new VOC limit values for 2011 and 2014 have been estimated for the years 2015 and 2020. For 2010 only a business as usual scenario has been created. The resulting reduction potentials result from a comparison of the total VOC emissions of the DECOPAINT scenario and the BAU scenario.

7.2.2.1. Business as usual scenario (BAU)

The BAU scenarios for 2010, 2015 and 2020 have been estimated based on the data provided by CEPE and the additional estimations for those countries where no data was available. These estimations are described above. For the BAU scenario no regulatory intervention with respect to the VOC limit values has been assumed.

7.2.2.2. DECOPAINT-NEW scenarios for option 8

Two different DECOPAINT-NEW scenarios were analysed with respect to furniture and musical instrument sector. For 2015, a scenario a) was calculated where the proposed VOC limit values are implemented in 2011 and a reduction potential for this proposal was estimated. Additionally, in scenario b), the proposed VOC limit values for 2014 were assumed to be implemented and the results were calculated. For both scenarios it has been assumed that the disappearance of solvent-based products will not lead to a decrease in consumption but is replaced by an increasing demand for water-based products.

For 2020, it has been assumed that the first phase of the new limit values from 2011 has already been implemented and thus, only scenario b) of new limit valued from 2014 onwards has been analysed. As a result, two different reduction potentials for 2015 and one value for 2020 have been estimated.

Table 80 presents the resulting reduction potentials for the EU-27 Member States plus Croatia and Turkey. A total reduction potential for the EU-27 Member States of about 26 kt for scenario a) in 2015 has been estimated. For scenario b) the total reduction potential for the EU-27 countries declines from about 40 kt in 2015 to 32 kt in 2020.

Table 80: Reduction potentials for option 8 per country

country	2015		2020
	scenario a) kt	scenario b) kt	scenario b) kt
Austria	0.47	0.72	0.51
Belgium	0.35	0.52	0.19
Bulgaria	0.06	0.09	0.07
Cyprus	0.08	0.12	0.12
Czech Rebublic	0.25	0.39	0.33
Denmark	0.37	0.56	0.50
Estonia	0.09	0.13	0.12
Finland	0.40	0.62	0.52
France	4.38	6.78	5.70
Germany	3.02	4.46	2.19
Greece	2.42	3.81	3.84
Hungary	0.46	0.71	0.65
Ireland	0.41	0.64	0.54
Italy	4.81	7.56	5.43
Latvia	0.10	0.15	0.14
Lithuania	0.17	0.24	0.22
Luxembourg	0.08	0.12	0.10
Malta	0.01	0.02	0.02
Netherlands	0.39	0.58	0.52
Romania	0.20	0.31	0.26
Poland	0.52	0.77	0.72
Portugal	0.55	0.88	0.81
Slovakia	0.10	0.15	0.13
Slovenia	0.25	0.39	0.34
Spain	3.84	6.07	5.29
Sweden	0.75	1.16	0.97
UK	1.06	1.77	1.48
EU-27	25.60	39.71	31.67
Croatia	0.09	0.14	0.12
Turkey	0.98	1.52	1.28

7.3. Economic Impacts

7.3.1. Impact on Public Authorities and Public Spending

Monitoring and Administrative Cost

Since there will be a number of new products coming under the scope of the directive, surveillance agents in Member States will likely require some upgrading in their training. Additional costs might also be foreseen in terms of additional testing of new products falling within the scope of the directive.

A number of Member States have indicated that they would expect increases in their costs resulting from the option (note that some Member States responded generally, identifying additional costs under "new products", and where this is the case, it is expected that those Member States would incur costs under this option).

7.3.2. Investment

Capital investment in new equipment, reformulation, etc,

Although consultees have not been able to provide information regarding the investment costs necessary to produce larger quantities of compliant products (as substitutes for the non-compliant ones), some information has been forthcoming on the investment required of professional users of the various different coating products.

Due to the fact that water-based coating takes longer to dry (curing times are highly affected by both humidity and temperature), the UK and Netherlands associations are of the opinion that drying equipment will be required and, in some cases, automatic spraying and coating equipment as well. The UK Association estimates that the cost of drying equipment could be in the region of €100,000 on small firms and €1 million for large firms at the 300g/l limit, with costs doubling at the 100g/l limit. The Netherlands Association costed air drying equipment for water-soluble systems at €10,000+ and UV driers for large firms coming in at €50,000+.

CEPE has indicated that an increased requirement for water-based coatings would require manufacturers to invest more in stainless steel equipment due to the corrosive properties that these types of coatings will exhibit.

7.3.3. Impact on Competitiveness and Trade in Relation to Trade with Non-EU Countries

7.3.3.1. Import penetration

During the stakeholder discussion forum held in May 2009, UEA, the European Furniture Manufacturers Federation, pointed out that imports of products likely to be affected by the option have tripled over the past decade as less expensive, good quality products have come onto the market. The introduction of this option would further exacerbate this situation, with production in Europe already decreasing. CEPE has reinforced this view, arguing that the competitive position of European furniture manufacturers would be weakened if they did not have access to the same coating products as their competitors. CEPE identifies these competitors as:

- third-country wood furniture producers, located in countries where no similar VOC regulations are in place and thus who still have access to the full range of coatings products;

- large installation holders that fall under the SED; and
- small installation holders in EU Member States that have included such installations under a national level SED.

The UK competent authority, along with the UK member of UEA, has stressed the negative impact that would likely result from the introduction of the measure on the UK reproduction furniture industry. Whilst the majority of furniture production in the UK is for the EU market (approximately 95%), a higher proportion of reproduction furniture is exported outside Europe. The limits imposed by the measure would pose serious difficulties in providing the finishes required in this particular niche part of the sector. It is estimated that there may be a potential 40% loss of market share for UK firms in the furniture sector (falling from a 70% share down to a 30% share against foreign competitors), and this situation could be worse in the reproduction furniture subsector as production shifts to countries that can use coating products with higher VOC contents.

7.3.3.2. Competitiveness of EU companies in external markets and exports

CEPE has estimated that 5% of the EU production of wood coating products is destined for the export market with 95% being consumed on the internal market. It is anticipated that those companies currently supplying non-compliant products above the option's proposed VOC limits would continue to supply these to their external markets, implying that a more limited production of these products (due to the reduction in the EU market) would still be viable for the companies that produce them.

7.3.4. Impact on Functioning of the Internal Market and Competition

7.3.4.1. Number of firms (entry/exit rates)

Consultees from associations in the UK and Netherlands identified that SMEs would be most affected by the option due to the fact that the use of water-based coatings will require companies to invest in drying equipment and SMEs would be most negatively affected by this need. In the Netherlands, the association felt that non-European suppliers would increase their share of the market for furniture requiring certain appearances and properties which cannot be provided by alternatives to solvent products. Consequently it was felt likely that some firms would leave the market, although CEPE estimates that all companies that are currently exporting non-compliant products to non-EU markets would continue to do so after the introduction of the option.

7.3.4.2. Barriers on new entrants, monopolies, market segmentation, special trade barriers

Both the UK and Netherlands associations felt that start-up costs for new entrants to the market would increase by at least 5% at the 300g/l limit and by

10% or more at the 100g/l limit. However, CEPE in their response to a consultation, suggested that they expected no significant increase in the start-up costs.

7.3.5. Impact on Innovation and Research

With the exception of the very top performing products in terms of glossiness, scratch resistance etc, it appears that there are alternatives to high VOC containing coatings already existing on the market. In that sense the need for research, development and innovation to develop compliant products will be less than might be the case with some of the other options and product groups.

CEPE believes that the main costs will be associated with the investment required to actually produce the compliant products.

7.3.6. Impact on Operating Costs and Conduct of Businesses (SMEs)

Very little information has been identified regarding the effect on SMEs that would result from the option. CEPE felt that SMEs which are currently producing non-compliant products might struggle to obtain market share if they were not able to adapt quickly enough.

7.3.7. Impact on end-users (consumers and professional end-users)

7.3.7.1. Productivity of professional end-users (labour time, re-application)

Curing times are highly affected by humidity and temperature (which suggests there will be regional differences regarding such impacts). The Netherlands Association estimates that lower VOC containing products will require increased drying times by up to 500% if driers are not used; this means that additional storage space will be required to store furniture whilst it is drying out.

As a result, operating costs for professional users of wood coating products could increase by between 2% and 5% at the 300g/l and 100g/l limits according to the UK Association consulted. In addition, the actual cost of low VOC containing products are often (much) higher than their high VOC containing equivalents. CEPE estimates this difference as being up to 10%. The UK trade association provided estimates of current average costs for coatings with different VOC contents as follows:

VOC > 300g/l = €3/kg

VOC 100 – 300g/l = €3.5/kg

VOC <100g/l = €4/kg

7.3.7.2. Quality/availability/consumer choice

CEPE, CEFIC SRM and national trade associations in the UK and Netherlands have identified coating qualities such as gloss, range of colours and chemical resistance as being important for furniture producers and which simply cannot currently be achieved at the VOC limits proposed by the option (i.e. by UV and water-based coatings). The Netherlands association has highlighted problems with certain wood species (e.g. oak) which suffer from raised grain when coated with water-based coatings, a problem that does not arise with solvent-based systems. They point to problems associated with alternatives such as UV-systems, which can only be applied to flat surfaces when 100% UV is used; water-based UV-systems also require large investment in equipment and can involve health problems (such as sensitivity).

The UK trade association, BFM, highlighted the effect of the proposed VOC limits on the manufacture of reproduction furniture. BFM states that it is not technically feasible to achieve the required finishes for this type of furniture with coatings that would meet the limits. Consultation with manufacturers also revealed problems with supplying furniture coating products to professional users. Use of emulsifiers is problematic as they are not distributed evenly, resulting in spots where they are more visible. Consultees felt that a 100g/l limit on VOCs is not feasible.

An association of musical instrument makers in the UK also pointed to problems that would arise in the performance of coatings for musical instruments, and rated the performance of solvent-based and water-based systems in a number of characteristics important to the manufacture of violins. These ratings (along with similar ratings provided by the Confederation of European Music Industries e.v. in brackets) are reproduced inTable 81.

Antique instruments in particular would exhibit problems with sound quality when they have to be touched up, and it would be impossible to achieve satisfactory matching with existing finishes.

Table 81: Performance of water-based and solvent-based coatings in violin making

Characteristic	Water-borne coatings	Solvent-based coatings
Transparency (gloss)	5 (2)	1 – 3 (1)
Scratch resistance	3 (3)	3 (2)
Chemical resistance	4 (-)	3 – 4 (-)
Sweat resistance	5	2
Wear through rubbing hands	5	2
Preservation of wood	5	1
Tonal qualities	5	1
1 = vey good performance, 5 = poor performance		

7.4. Social Impacts

7.4.1. Health impacts

The implementation of the option will result in a reduction of anthropogenic VOC emission which may result in a marginal reduction of average ground level ozone concentration in EU-27, Croatia and Turkey. As described before for option 8 two VOC-reduction scenarios have been considered (i.e. Scenario a) and Scenario b)) with slightly different VOC reduction potentials. In the following table the modelled effects on human health due to this change in the air quality are shown. For the calculations average meteorological conditions and the 2020 reference emission scenario have been used. The figures in the table take into account that the VOC reductions within EU-27+2 will also change the exposure of population in neighbouring countries (total Europe, EMEP grid). By considering only the impacts within EU-27 and Croatia/Turkey the externalities will slightly decrease to €5.61 million for 2015 and €4.21 million or 2020 (Scenario b).

Table 82: Health benefits due to reduction of VOC emissions related to ground level ozone reduction

		2015		2020
		Scenario a)	Scenario b)	Scenario b)
Reduced external costs	[€_00][61]	4,846,165	7,487,706	5,702,260
Mortality	YOLL	34.663	53.557	40.786
Morbitity RHA, ages over 65	cases	19.62	30.32	23.09
MDR, ages 18-64	days	78,316	121,005	92,151
RMU by adults	cases	28,449	43,956	33,475
RHA = cases of restricted hospital admissions; MDR = restricted activity days, RMU = cases of respiratory medication use, YOLL = Years of Life Lost				

7.4.2. Impact on employment

In the absence of clear information on the numbers of companies producing non-compliant products and operating in the furniture and musical instrument sectors, it is impossible to predict the impact on employment that might arise from implementation of the option. However, the effect is likely to be a negative one. The UK trade association estimated that there would be significant job losses in the sector, in the region of 40,000 resulting from the introduction of the option, as production activities would move outside of the EU.

[61] The monetary values reported in this table are expressed in Euro on the basis of the value of the Euro in the year 2000. The estimation of the monetary values expressed in Euros of 2000 enables a comparison of the monetary values estimated for 2015 and 2020.

7.5. Environmental Impacts

7.5.1. Changes in the Ground Level Ozone Concentration

The reduction of VOC emissions may reduce the ground level ozone concentration in Europe. The correlation between the VOC emission reduction and ozone concentration is a non-linear and it is influenced by a number of parameters, e.g. the NO_2 background concentrations and the meteorological conditions have a relevant impact on the processes. The region or country where the VOC emissions are reduced have as well a relevant impact on the European wide changes in the ozone concentration.

The impacts of option 8 and the two VOC-reduction scenarios on the ground level ozone concentrations are shown in the following table. For the calculations average meteorological conditions and the reference emission scenario for 2020 have been assumed. The impacts of the option have been assessed for the years 2015 and 2020.

Table 83: Impact of option 8 on the average ground level ozone concentration within EU-27 + Croatia and Turkey.

	average O3 concentration [ppb]	
	changes in [ppb]	percental changes
Scenario a)		
2015	0.003	0.009%
Scenario b)		
2015	0.004	0.014%
2020	0.003	0.011%

The ozone reduction may contribute to prevent part of the production losses due to crop damage. The benefit of the VOC reduction due to the scenario a) of option 8 has been quantified for 2015 to €2.28 million. The benefit as calculated by the VOC-reduction scenario b) of option 8 has been quantified to €3.52 million for 2015 and €2.59 million for 2020.

7.5.2. Cross-Media Effects and Energy Consumption

The Netherlands trade association reported that users of water-based coatings tend to rinse equipment with water and dispose of the waste down the sink. They also pointed to the fact that energy use will increase due to the amount of forced drying that will be necessary in order to speed up the drying of water-based coatings. CEPE and the UK based trade association also referred to an increase in energy consumption due to the increased use of spraying equipment that might be required to achieve the desired finishes for some applications.

7.5.3. Fuel Consumption, Emissions and the Use of Renewable and Non-Renewable Resources

Both CEPE and the Netherlands trade association indicated that there would be zero impacts regarding fuel consumption and emissions associated with transport of products and a zero impact regarding the use of non-renewable and renewable resources.

7.6. Summary Impact Assessment

The following table summarises the different impacts that are likely to arise from implementation of the option to extend the Directive to wood coating products as utilised in the furniture and musical instrument sectors. The ratings are based on the information set out in the preceding chapters.

Table 84: Summary Impact Assessment, wood coatings

Stakeholder Impact	Manufacturers	Professional Users	Consumers	Member State Authorities
Economic				
Capital/investment costs	-/?	--	0	n/a
Operating costs	Unknown	-	0	-/?
Product and raw material prices	Unknown	-	-	n/a
Imports/competitiveness	-/?	--	n/a	n/a
Competition	-/?	-	n/a	n/a
Entry costs	-/?	-	n/a	n/a
Innovation/research	-/?	0	n/a	n/a
Product performance	n/a	-- and - and 0 depending on product	-- and - and 0 depending on product	n/a
Monitoring/Surveillance costs	n/a	n/a	n/a	-/?
Social				
Employment	-/?	-/?	n/a	n/a
Health				
Environmental				
Cross media	-/?			
Waste and recycling	-/?			
Fuel consumption vehicle emissions	0			
Use of renewable/non-renewable resources	0			
Key: 0 = no impact +/- = uncertain impact positive or negative -/? = likely slightly negative impact but unquantifiable due to lack of data + = Positive impact ++ = Strongly positive impact - = Negative impact -- = Strongly negative impact				

Annex 8

8. Paint aerosols – Technical background information, VOC reduction potential

8.1. Information collection on aerosols for paints

Article 9 of Directive 2004/42/EC invites the Commission to review the product group 'aerosols for paints and varnishes', as a potential candidate for scope extension.

'Aerosols for paints in varnishes' are paints and varnishes that are supplied in spray-cans. Major sources of information in this chapter comprise internet sites of manufacturers, literature, and a 'briefing paper' that was developed by a working group of CEPE and FEA [CEPE/FEA, 2008] and that was discussed on a meeting with CEPE/FEA on 05/09/2008.

8.1.1. Description of the product group

In annex I-2 of Directive 2004/42/EC, aerosols for paints and varnishes that are used in the vehicle refinish sector are covered. Therefore, in the paint sector, the candidate product group for the extension of the scope of the directive includes only the remaining aerosols for paints and varnishes, also called 'non-automotive' aerosols. These belong largely to the group of *decorative* paints and varnishes, although some may be used inside installations as well.

CEPE and FEA define 'non-automotive' paint aerosols as follows:

"Non-automotive aerosols containing paints and varnishes used to decorate and/or protect furniture, accessories, radiators and appliances."

These paint aerosols include primers, metallic and non-metallic topcoats, glitter sprays, fluorescents, hammer finishes, chrome-effects, clear varnishes etc. A short Internet survey of products that are supplied to the market by three major manufacturers (Motip Dupli, Rust Oleum, Den Braven) has shown that there is a large product variety. At least 40 product types could be distinguished, ranging from anticorrosion primers for metal parts, to topcoats that are marketed for application on various substrates, including wood, glass, plastic as well as metal.

'Non-automotive' aerosol paints are formulated to deliver an even coating that dries quickly to leave a smooth finish. These coating systems need to be dissolved in a carrier solvent for application. These solvents, e.g. acetone, need to be quick drying and should be compatible with both paint resins and propellants (i.e. the liquefied gases that enable spray application).

VOC contents stated in the technical documentation of manufacturers ranged from **436 g/l to 890 g/l**. Stated VOC emissions per m^2 of substrate covered (depending on the spreading rate and coverage) ranged from 41 to 280 g/m^2. According to industry, typical VOC-contents of products that are in scope of the above definition range from **520 to 840 g/l** [CEPE/FEA, 2008].

Common binders of non-automotive aerosols for paints are one-pack acrylic, nitrocellulose and alkyd resins, and combinations of these.

The non-automotive aerosol paint industry sector is characterised by paint manufacturers ('fillers') who are SMEs. Those small companies have no or low export outside European Union [CEPE/FEA, 2008].

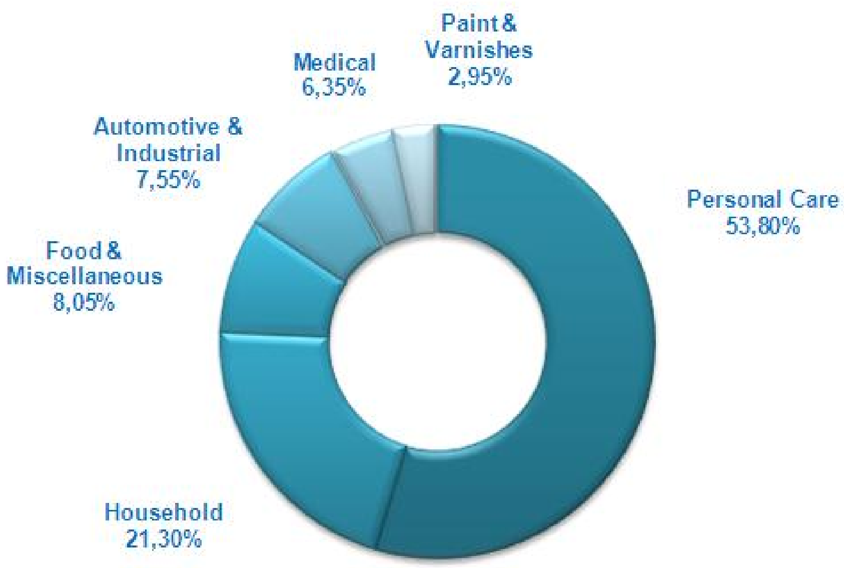
8.1.2. VOC emissions due to aerosols for paints and varnishes

Preliminary calculations of VOC emissions due to non-automotive aerosols for paints in the EU have been made on the basis of production statistics from the FEA website, and a few assumptions that were taken from literature. Subsequently, estimates from industry have been received.

8.1.2.1. Preliminary estimation

On FEA website it is stated that Europe is the world's largest aerosol producer. More than 5.4 billion aerosol units (spray cans) were produced in Europe in 2006. FEA represents 530 companies active in the aerosol industry from most countries in the European Union [FEA 2008]. Member associations are present in 18 countries (16 EU + Turkey & Switzerland).

The figure below, taken from the FEA website, indicates that the European production of automotive and non-automotive paint aerosols together was 159 million cans in 2007 (5.4 billion cans x 2.95%).



[FEA, 2008]

Figure 13: European Aerosol Production Share in 2007

From a - relatively old - paint aerosols study in literature (CREM, 1994), some assumptions were taken in order to make a preliminary calculation of the VOC emissions:

- 35% of the units contain 150 ml of paint; 65% contain 400 ml of paint;
- the average relative weight of the products is 840 kg/m^3;
- the average VOC content of an aerosol paint = 80%.

This results in VOC emissions from automotive and non-automotive aerosol paints in Europe ('EU-18' according to FEA members' countries) of **± 33.5 kt** (baseyear 2007).

8.1.2.2. Estimation CEPE/ FEA

After consulting their member associations and companies, CEPE and FEA arrived at an estimated VOC emission of 'non-automotive' paint aerosols in Europe of **19.7 kt** per annum (2007 figures). A summary of the method and the assumptions made has been provided to the consultants:

"On a confidential base, major producers provided their EU production figures (number of aerosols / units) for automotive and non-automotive paint aerosols. Additionally the figures have been split into three different nominal volumes.

The collected data has been extrapolated with the production figures (number of aerosols / units) from the FEA statistics. An average density and an average VOC content have been agreed (expert judgment).

Based on historical production figures (units), forecasts of VOC emissions of paint aerosols for 2010 and 2020 were respectively estimated to **21.1** and **25.5 kt**." [D'Haese, 2008a]

The CEPE/FEA estimate for non-automotive paint aerosols alone is slightly higher than the 'preliminary' estimation. CEPA/FEA experts retrieved up-to-date information on can sizes, product density and relative market shares of automotive and non-automotive aerosols. Moreover, the estimates cover EU-27. Therefore, it may be assumed that the CEPE/FEA estimates are the most accurate estimates.

Assuming that the CEPE/FEA estimates are the most accurate estimates, the total VOC emissions from automotive and non-automotive aerosols for paints together would be **39.4 kt**. However, as stated before, automotive paint aerosol products are in the scope of Directive 2004/42/EC already.

For the moment, it seems reasonable to state that VOC emissions due to the use of non-automotive paints are relatively small (appr. 0.2% of total VOC emissions, and **1.3%** of VOC emissions from 'solvent use' (cat. 3D, 1473 kt).

8.1.3. VOC reduction options and reduction potential

CEPE and FEA have commented on the 'historic' reasons of the development of aerosol-type paints, and their advantages. This type of information is very relevant if the VOC-reduction potential within the product group has to be predicted.

'Non-automotive' paint aerosols are paints packed in aerosol dispensers (spray cans). According to industry, the use of those paint aerosols has the following advantages:

- they are ready to use and convenient products;
- they allow easy application of the product on complex surface profiles (e.g. bicycles, radiators) – also for recoating and touch-up (small repairs);
- they permit the application of special effect finishes on small items;
- they eliminate the use of solvents for cleaning of application equipment;
- the spray cans are hermetically sealed, providing a long shelf-life;
- they are an easy solution for spraying paints without using spray guns.

The use of liquefied gases (VOC) is essential for aerosol paint packaging/ application systems. In order to ensure the spraying ability, the paints have to be diluted, which requires a certain additional amount of VOC solvent. VOCs used as propellants in 'non-automotive' paint aerosols are the liquefied gases propane/ butane and dimethyl ether. In addition, various solvent mixtures are used with acetone contributing the biggest volume.

Literature sources from the early '90s learnt that a number of 'emerging technologies' were described at that time [CREM, 1993]. These were compared to the traditional aerosol products, which were assumed to contain 80% VOC on average. The emerging technologies identified included:

- Novel spraying systems, such as 'pump & spray' and 'bag in can'. These were not regarded feasible yet at that time.
- Alternative propellants: compressed gases such as CO2, N2 and compressed air. These were not considered feasible (yet) too.
- Water-based aerosols (65% VOC), using dimethyl ether as a propellant. Prototype products existed, but they were not state-of-art yet.
- High Solids aerosols (65% VOC). For this alternative too, prototype products were known, but these too were not state-of-art yet.

According to industry, for a vast majority of 'non-automotive' paint aerosols it is not (yet) technically feasible to reduce VOCs and retain product performance at the same time. Paint technologists have developed a number of systems that can be used to reduce the VOC content of paints. Unfortunately these are - according to CEPE/FEA - not suitable for 'non-automotive' paint aerosols, for the following reasons [CEPE/FEA, 2008]:

- High solid coatings, i.e. 'concentrated products' with a higher content of solids, are applied in many industrial processes. However, they generally require adapted spraying devices, to enable the more viscous products to be sprayed. In order to be applied as an aerosol, the high solids coating would have to be diluted to conventional VOC-content again, thus negating the VOC reduction benefit.
- Water-borne coatings: industry made attempts to place such water-based systems on the market but technically they were unsatisfactory and not viable for the following reasons:

e) Incompatibility between resins and propellants

Most waterborne coatings are not stable once a propellant is added because it will dissolve the dispersion or emulsion. As only one propellant is possible with water-based materials (dimethylether), the choice of raw material is limited. Thus, only a few waterborne coating systems are compatible in paint aerosols. However, these have not gained acceptance in the market [CEPE/FEA, 2008]

f) Poor atomisation of water-based paints when used in aerosol dispensers.

Main disadvantages of waterborne aerosol coatings that have been observed, compared to solvent-based products, were [CEPE/FEA, 2008]

- uneven flow
- lack of gloss
- 'spitting'
- foam formation.

g) Poor coating properties

Disadvantages of waterborne aerosol coatings tested so far included longer drying times, worse adhesion on some surfaces, poor resistance against water and weather (exterior applications), and less scratch resistance [CEPE/FEA, 2008]. However, these properties might be improved I the future, similar to developments in general waterborne coating technology.

h) Safety concerns when metallic ingredients are used with water; for example, if zinc is present hydrogen could be formed.

Two-pack (reactive) coatings: at the moment there are some two-pack spray-can technologies on the professional/industrial market. However, these paint aerosols cannot be used by consumers because of the need for personal protection equipment. Additionally, pot life (product shelf life after first use) is only of several days – as compared to years for conventional products.

Discussions on these issues during a meeting with CEPE and FEA (05/09/'08) learnt that not much seems to have changed since the early 1990's. Current technologies for high solids in decorative paints for brush and roller application, using lower molecular weight binders, seem not to be feasible (yet) for spray application in combination with propellants.

8.1.4. Conclusion on non-automotive aerosols for paints

The relative contribution of non-automotive aerosols for paints to total VOC emissions is rather small. The large variety in product types would mean that including aerosols for paints in the Directive might be very complicated, as grouping is difficult and clear definitions would be necessary with VOC limits for all of the 40 (or more) product types.

Although the observed range in VOC content expressed as gramme VOC per litre of product is roughly a factor 2. This range mainly seems to reflect variations *between* product types, and not *within* product types.

Probably, the VOC reduction potential may be very small if one sticks to the 'spray-can type' of product. The ‘emerging technologies’ described in the 1990’s resulted in a theoretical VOC reduction of 11 % for the water-based aerosols and 14 % of the high solids aerosol, if calculated as g/l VOC [CREM, 1993]. If one would assume a 10 % reduction potential al over the product group of non-automotive aerosols for paints, the resulting *theoretical* VOC reduction potential for the EU would be **1.9 kt**, i.e. without considering actual feasibility, which is low.

Another, far reaching option might be a phase-out of the spray-can type, and substitution by brush or roller application, or compressed-air spraying equipment. However, it is very questionable whether that would be feasible for this product group without compromising performance in the specific applications that aerosols are used in. In addition, it is questionable whether such an 'extreme' measure would be justified by the total VOC reduction potential at EU-scale.

Annex 9

9. Protective coatings – Technical background information (Option 9)

9.1. Description of the product group

Protective coatings prevent and/or controll degradation of infrastructure. Protection and preservation of different materials is achieved, like concrete, steel and other industrial or marine structures/surfaces.

At present, Directive 2004/42/EC addresses protective coatings only when coatings are applied to 'buildings, their trims and fittings, and associated structures for decorative, functional and protective purpose.' (annex I-1).

Protective coatings currently belong to category 1 (i) 'one-pack performance coatings', defined as 'performance coatings based on film-forming material. They are designed for applications requiring a special performance, such as primer and topcoats for plastics, primer coat for ferrous substrates, primer coat for reactive metals such as zinc and aluminium, anticorrosion finishes (…).'

Current limit values of this category distinguish between water-based products (VOC limit 140 g/l) and solvent-based products (VOC limit 600 g/l in 2007, 500 g/l in 2010).

9.2. Member State problems because protective coatings are not covered

The Member States have been asked whether they have observed problems because protective coatings are not covered, and been asked for description of the problem and suggestions for possible solutions.

Table 85 shows 4 Member States out of 22 answers reporting problems.

Table 85: Problems reported by Member States because protective coatings are not covered by Directive 2004/42/EC

Manufacturers may bring products out of scope	Protective coatings not usable for "buildings" are out of scope	Problem of categorisation	No Problems
BE	SI	FI	AT, BG, CY, CZ, EE, EL, ES, HU, IE, LT, LV, MT, NL, PL, RO, SE, SK, UK

9.2.1. Description of the problems

Products brought out of scope

Belgium states that "a lot of products can be considered as well as deco as protective coatings, particularly in housing situation" [BE Quest, 2008]. Thus, products might be brought out of the scope of the Directive by declaring the product a protective coating.

Products not covered by the scope

Slovenia mentions that the non-inclusion of protective coatings leaves products out of the scope but considers this as a “minor problem” [SI Quest, 2008]. They report that “there are special metal coatings used i.e. for heavy duty vehicles or for special products like glass frames that are out of the scope of the directive“ [SI Pers, 2008].

Categorisation problem

Finland reported to have categorisation problems related to protective coatings resulting in misunderstandings with manufacturers. [FI Pers, 2008]

9.2.2. Member State suggestions to solve problems due to non-inclusion of protective coatings in the scope

Suggestions where made by 4 Member States (AT, BE, LT, RO), not exclusively by those which reported to have problems.

Proposals to include protective coatings

Belgium suggests to “extend gradually the scope to all coatings products used in housing and building situations and car coatings. Extension to protective coatings and furniture coatings are the logical next steps” [BE Quest, 2008].

Austria states, that “almost all coatings have protective functions, too” but they “experienced that problems in regard to definition could occur in case of heavy duty anticorrosives” [AT Quest, 2008]. In practice, those products on the market would fall below the maximum VOC content required for performance coatings which are covered by the Directive. Thus, Austria suggests those heavy duty anticorrosives “could be classified under category e, i or j” [AT Quest, 2008].

Suggestions for clear definitions of protective coatings

In the case “that the Directive will cover all types of protective coatings”, Romania suggests “that these should be clearly specified in the Directive” [RO Quest, 2008].

9.2.3. Industry proposal to solve problems due to non-inclusion of protective coatings in the scope

During the meetings with the consultants, CEPE has commented problems when implementing Directive 2004/42/EC due to different interpretation of the scope by Member States. As protective coatings often fulfil an additional decorative purpose, they may be considered as decorative coatings.

CEPE has reported that some Member States extend the scope of the directive to constructions not being buildings, their trims and fittings or associated structures, like bridges, power poles, bridge railings etc.

To harmonize European legislation on protective coatings, CEPE has provided a position paper to the consultants proposing the inclusion of protective coatings into the scope of Directive 2004/42/EC [CEPE, 2008e] (see Annex 38).

9.3. VOC emissions due to protective coatings

For CEPE, a breakdown of the protective coatings market was very difficult because of the unavailability of factual data (see CEPE position in annex 38).

'Estimates suggest that on-site applications account for between 35 and 40% of total paint volume, the precise proportion varying depending mainly on economic factors, which affect the ratio of new construction to maintenance carried out in the sector.' [CEPE, 2008e]

CEPE has estimated that the protective coatings market within EU-15 in 2005 was 171 kt of paint and solvent and 202 kt for EU-25. VOC emissions were estimated with 55.3 kt for EU-15 and 65.5 kt for EU-25.

Furthermore it was estimated that installations covered by Directive 1999/13/EC and exceeding a solvent consumption threshold of 5 tonnes of solvents use 50 % of the products, 10 % is used in installations not exceeding the threshold.

Based on this, CEPE has estimated that outside of activities covered by Directive 1999/13/EC about 40 % of the market volume is used. VOC emissions from this part of the total market are estimated with 26.2 kt in EU-25.

9.4. VOC reduction options and reduction potential

According to CEPE, changes in protective coating systems are difficult to achieve and the protective coatings market, therefore, is very much based on performance testing and approvals.

Protective coatings use primarily solvent-based systems, but some water-based and solvent-free systems are also used. Solvent-based protective coatings may require the addition of thinners prior to use. Additional solvents are used particularly in cold conditions to enable efficient spraying.

Water-based coatings usually contain additives classified as VOC, such as materials to aid film coalescence or to retard drying.

Although technologies for water-based products are continually improving, CEPE believes that replacement will predominantly be achieved inside of installations where application and drying conditions can be controlled.

CEPE has proposed the inclusion of 7 categories of protective coatings and related VOC limit values, proposing a determination of the solvent content in the 'ready-for-use' product (see annex 38).

CEPE estimates that application of the proposed VOC limit values would lead to a VOC reduction of 5.2 kt per annum, reducing annual VOC emissions from on-site protective coating applications from 26.2 kt to 21.0 kt (- 20 %)

9.5. Conclusion regarding protective coatings

The seven categories proposed by CEPE for inclusion of protective coatings into the scope of Directive 2004/42/EC propose VOC limit values for primers and intermediates with 290 g/l and VOC limits for all other categories between 370 and 460 g/l. For one category, ‘intumescent coatings’, an alternative option for water-based products is proposed with a limit value of 140 g/l.

All proposed limit values for solvent-based products are stricter than current limits for decorative products for corrosion protection (VOC limit 600 g/l from 2007 on and 500 g/l as from 2010). The proposed limit value of 140 g/l for water-based intumescent coatings is identical to the existing limit for water-based decorative protective coatings.

A **VOC reduction potential of 5.2 tonnes** is estimated by CEPE from an inclusion of the seven proposed categories for protective coatings into the scope of Directive 2004/42/EC, based on CEPE sector data (chapter 9.3, see also CEPE proposal on protective coatings in annex 38).

Annex 10

10. Protective coatings – Impact Assessment (Option 9)

10.1. Description of Options and Background Information

10.1.1. Option 9

The proposal assessed here was drawn up by CEPE and focuses on the inclusion of in-situ applications of seven categories of protective coatings into the scope of Directive 2004/42/EC, thus achieving a reduction in VOC emissions from the relevant products and eliminating problems stemming from implementation of existing Directive 2004/42/EC in relation to protective coatings. The proposal thus also aims to establish harmonised legislative requirements on protective coatings throughout Europe.

The details of the proposal are given in Table 86 and Table 87 below, with Table 86 providing the CEPE proposal of the wording of an amendment to Directive 2004/42/EC and Table 87 lists the proposed limits on VOC content.

Table 86: CEPE Proposal (Draft Wording for New annex I – Scope – Section 3 – Protective Coatings)

3. For the purposes of this Directive, 'Protective Coatings' mean products applied on site and listed in the subcategories below. They are used for chemical resistance, corrosion and fire protection of metal and concrete structures. They are not used for coating of decorative panels and claddings, for decorative applications defined in section 1 above, nor for ships, Floating Production Storage and Offloading Vessels (FPSOs) or other mobile marine craft. Example applications include – typically but not exclusively – protection of structural framework of steel-framed buildings, designed to provide long-term structural support and integrity. Concrete, steel and other metallic structures such as petrochemical facilities - including oil and chemical storage tanks – offshore structures such as jetties and oil and gas platforms; infrastructures such as bridges, dams, waterworks, and harbour facilities; pipelines, seagoing containers and power generation, including nuclear, hydroelectric, coal, oil and gas powered stations and sustainable energy facilities. 3.1. Subcategories. a) 'multi-pack primers and intermediates' means chemically curing anticorrosive primers (excluding zinc pigmented primers (see 'b'), prefabrication primers, etching primers, holding primers and sealercoats), for steel and other reactive metals such as zinc or aluminium, including primers formulated for application onto poorly prepared, contaminated and damp surfaces, and special primers for adhesion to concrete. This category also includes two-pack barrier coats and build coats / undercoats, including those with functional pigmentation, such as micaceous iron oxide, or those formulated purely using opacifying pigments and fillers. Apart from long term anticorrosive protection, these products are used for a variety of specialised applications, including heavy duty floor and bund coatings for metal and concrete surfaces providing, for example, chemical and abrasion resistance or self-levelling properties. Also primers for immersed surfaces and those used as base coats for high-performance topcoats such as chemical resistant finishes. b) 'zinc primers' means anticorrosive primers pigmented with sufficiently high levels of zinc to provide sacrificial protection for metallic surfaces. These can be formulated in organic resins – such as epoxies or polyurethanes (including moisture cured polyurethanes) – or in inorganic silicate media. They are generally used in conjunction with a high-performance topcoat where a high degree of corrosion protection, or long term durability, is required. Inorganic zinc primers may also be used for high temperature resistance and in some specialised tank lining systems. c) 'one-pack primers and intermediates' means the same as for multi-pack primers and intermediates, but the products are formulated on single component resin systems which cure by evaporation, oxidation or reaction with atmospheric moisture.

d) 'tank coatings' means one- or two-pack coatings designed for application in single or multi-coat (primer + topcoat) systems for lining chemical or water storage tanks. These systems are specially formulated to have enhanced water and/or chemical resistance.

e) 'multi-pack finishes' means high performance chemically cured topcoats with good chemical, water and/or weather (UV) resistance, but excluding specialised high temperature resistant finishes. These coatings are normally used in conjunction with two-pack chemically cured primers and intermediates, and they must therefore display good compatibility with and adhesion to, in particular, category (a) and/or (b) products. The particular properties exhibited by these finishes depend on their end use, and range from chemical resistance to immersion or heavy duty non-skid floor finishing. Multi-pack finishes also include products designed for application directly to the substrate to provide both protective (anticorrosive) and decorative functions in a single application. They may be gloss, semi-gloss/sheen or matt in appearance.

f) 'one-pack finishes' means the same as for multi-pack finishes, but the products are formulated on single component resin systems which cure by evaporation, oxidation or reaction with atmospheric moisture. They are
normally used in conjunction with category (c) or (a) products.

g) 'intumescent coatings' means specialised fire protection coatings which react and intumesce (swell) on heating to create an insulating layer. This restricts the increase in substrate temperature and delays or prevents structural collapse in fire situations. Coatings which do not protect the structural integrity of a building, but which prevent the surface spread of flame through intumescent or other reactions, are excluded.

Table 87: VOC Limits in Protective Coatings Proposed by CEPE for inclusion in annex II of Directive 2004/42/EC

	Product Sub-category	VOC limit (ready to use) – g/l (proposed from 1.1. 2012)
a	Multi-pack primers and intermediates	290
b	Zinc primers	460
c	1-pack primers and intermediates	420
d	Multi-pack finishes	420
e	1-pack finishes	440
f	Tank linings	370
g	Intumescent coatings (Solvent-borne)	440
	Intumescent coatings (Water-borne)	140

10.1.2. Exemption clause

In addition, CEPE proposed to extend the exemption procedure available to Member States under Directive 2004/42/EC to cover so-called 'specialty applications' of protective coatings (see Table 88 below for details).

Table 88: Proposed amendment of 2004/42/EC – Article 3, Clause 3

'Member States may grant individual licences for the sale and purchase in strictly limited quantities of products which do not meet the VOC limits laid down in annex II:

- For the purposes of restoration and maintenance of buildings and vintage vehicles designated by competent authorities as being of particular historical and cultural value, and

- For highly specialised end uses where the cost and/or time required for the testing and approval process is disproportionate to the benefit gained, or where the consequences of product failure may compromise safety, health or the environment.

CEPE provided the following reasons for the need to provide an exemption procedure: some markets for specific protective coatings only require small amounts of coatings while testing of new products is said to be as time-consuming and expensive. By means of example, some coatings for the nuclear industry require testing prior to introduction onto the market which may take up to between 12 -15 months and as such it would not be feasible to apply the proposed limits to such products.

In addition, it was argued that to minimise impacts onto coatings manufacturers, in particular SMEs, the proposed limits should only come into force following a transition period, with the date suggested by CEPE being 2012.

10.1.3. Summary of Consultation

We conducted consultation on the impacts of the above proposal with interested stakeholders and we received responses from the following associations:

- **CEPE** (while the proposal originates from CEPE and some information on impacts of the measure was provided with the proposal, the association was consulted further in order to elaborate on the expected impacts); and
- **AVNH** (Association of Paint Manufacturers of the Czech Republic).

The information gathered from the above associations and from individual company(-ies) form the main input in this impact assessment.

10.1.4. Background Information on Protective Coatings

Protective coatings are coatings applied to prevent and/or control degradation of material. Protective coatings are currently covered by Directive 2004/42/EC where they are applied to “buildings, their trims and fittings, and associated structures for decorative, functional and protective purposes.” Where Directive 2004/42/EC applies, protective coatings are treated as belonging to Category i) one-pack performance coatings, with Phase I VOC limits being set at 140 g/l for water-based products and 600 g/l for solvent-based products and Phase II VOC limits (to come into force in 2010) set at 140 g/l for water-based products and 500 g/l for solvent-based paints.

CEPE notes that the protective coatings market is quite specific in that it is based on approval procedures with products undergoing testing and approval processes before they are considered as suitable by clients. Companies subsequently choose the most cost-effective products from the relevant list of approved coatings.

10.1.5. Expected Impacts of the Proposed Option (General Introduction)

CEPE provided 2003 data on VOC levels in current coatings thus comparing actual (2003) VOC levels with proposed limits. These data are given in Table 89 below.

Table 89: Proposed VOC limits and actual VOC concentrations (2003)

Product type	CEPE proposal for maximum VOC content (g/l ready to use)	VOC maximum values in 2003 (g/l ready to use)
2-pack Primers and Intermediates	290	445
Zinc Primers	460	570
1-pack Primers and Intermediates	420	550
2-pack Finishes	420	480
1-pack Finishes	440	540
Tank Linings	370	470
Intumescent Coatings SB	440	460
Intumescent Coatings WB	140	No data
Source: CEPE		

Table 89 above shows that the proposed limits are lower that the 2003 maximum levels indicating that there are products on the market that would not comply with the proposal. However, CEPE notes that there has been a substantial decline in average VOC contents since 2003, stressing that no data is available on the proportion of products presently not complying with the proposed limits.

The input from AVNH notes that paint manufacturers in the Czech Republic produce paints in all categories detailed under this proposal and VOC content in current products in general exceed the proposed limits.

Consultation with coatings manufacturers identified a company that manufactures protective coatings falling under almost all categories listed in the proposal but offering compliant products in one category only.

10.2. VOC and ozone reduction potential

10.2.1. Availability of data

Data for the estimation of reduction potentials with respect to new VOC limit values for protective coating products was provided by CEPE. The data was provided for several sub-categories of protective coatings including the above mentioned seven sub-categories for which new limits for VOC contents were proposed.

Detailed data was provided for the EU-15 on an aggregated level. Data with less detail, including sector activity data and total VOC emissions for the EU-25 was also made available by CEPE. The information allowed for an estimation of total sales and total VOC emissions for the EU-25 for the years 2010, 2015 and

2020. To extrapolate the given information to EU-27+2 level, the proportion of total population of the EU-25 and the EU-27+2 was applied. The data on population was taken from the EuroStat database.

In addition to data for the years 2010, 2015 and 2020, CEPE provided data for a scenario of maximum technical feasible reduction (MTFR) which was also analysed with respect to the reduction potential of VOC emissions.

The data provided by CEPE and the proposed VOC limits result in a set of VOC contents that had to be regarded with respect to protective coatings. First, the contents of current products were extracted from the data CEPE provided for the profile of the protective coatings sector. Second, different contents were also provided by CEPE and are assumed to present the current maximum levels. Third, the new regulations as proposed by the project team in collaboration with CEPE are shown. All these VOC contents were assumed to be valid for 2010, 2015 and 2020. Additionally, another different set of VOC contents was provided by CEPE for a scenario of maximum technical feasible reduction (MTFR) for 2020. The table below summarises the applied VOC contents.

These different VOC content values for the seven sub-categories can be found in the table below.

Table 90: Different VOC content values for option 9

Product Subcategory		Average contents provided by CEPE	Maximum VOC limits provided by CEPE in comment	CEPE / DECO-PAINT proposal	Additional limits for 2020 MTFR from CEPE table
Multi-pack primers and intermediates		340	445	290	220
Zinc primers		460	570	460	370
1-pack primers and intermediates		450	550	420	360
Multi-pack finishes		350	480	420	350
1-pack finishes		440	540	440	380
Tank linings		152	470	370	152
Intumescent coatings	Solvent borne	302	440	440	302
	Water borne	100	No data (assumption: 140)	140	100

10.2.2. Description of scenarios and estimation of reduction potentials

The estimation of the reduction potential is based on the analysis of three different years, 2010, 2015 and 2020. For each of these years three different scenarios of VOC limits (in g/l) were regarded. Additionally, for 2020 one further scenario of maximum technical feasible reduction was regarded. A detailed description of the different scenarios will follow in this chapter.

10.2.2.1. Business as usual scenarios (BAU)

The BAU scenario represents the case where no new regulatory measures have been introduced to the market and where the only changes can be found in the amount of sales and the VOC emissions resulting from these sales.

For protective coatings two different BAU scenarios have been estimated for the years 2010, 2015 and 2020. First, a BAU scenario included the average VOC contents which were provided in the original CEPE tables. These values can be found in the first column of the table above. As CEPE provided data for the years 2010, 2015 and 2020 no extrapolations and projection of the data was accomplished. The second BAU scenario is based on identical data for sales for the seven sub-categories of protective coatings. In contrast to the first BAU scenario, the values for VOC contents refer to maximum values of VOC contents as they are current found in the products. These VOC limit values are shown in the second column of the table.

10.2.2.2. DECOPAINT-NEW scenarios for option 9

The introduction of new VOC limit values will lead to changes in the total VOC emissions for the seven sub-categories of protective coatings. The first DECOPAINT-NEW scenario that was analysed refers to identical data on sales for the respective year 2010, 2015 and 2020. For the VOC limit values, the proposed new values as shown in the third column of the table were assumed to be implemented.

Sales data for the MTFR scenario differs from sales data for the BAU scenarios for two categories (2-Pack Anticorrosive Primers & Intermediates and 1-Pack Primers & Intermediates). These data were provided by CEPE. In order to get the estimates as realistic as possible, sales data for the DECOPAINT-NEW scenario in 2020 have been adjusted relative to the “total” change in sales between the BAU and the MTFR scenario. This adjustment has also been made for sales data in 2015, as this reflects the dynamics of the market which is going to underlie changes in demand not only in 2020 but also in the years between 2010 and 2020. If these adjustments with respect to market developments towards an MTFR scenario are not assumed to occur and sales data remains as given for the BAU scenario, negative reduction potentials arise for the comparison of the DECOPAINT-NEW scenario and the first BAU scenario.

The estimations of reduction potentials refer to the differences in the VOC emissions between the two BAU scenarios and the DECOPAINT-NEW scenarios (scenarios a) and b) for each of the years. Scenario a) refers to the differences in VOC limit values between the CEPE/DECOPAINT proposal (column 3 ofTable 91) and the average contents as they were provided by CEPE (column 1 ofTable 91). On the other hand, scenario b) compares the VOC emissions resulting from the proposed limit values of CEPE/DECOPAINT with the maximum VOC limits provided by CEPE (column 2 ofTable 91). Both scenarios have been calculated for 2010, 2015 and 2020.

In addition, the VOC emissions for the BAU scenarios and the MTFR scenario for 2020 (scenario c) and d)) have been compared. In scenario c), the VOC emissions resulting from the MTFR limit values for VOC (column 4 ofTable 91) have been compared to the emissions from the average contents as they were provided by CEPE (column 1 ofTable 91). And in scenario d) the VOC emissions of the MTFR limit values (column 4 ofTable 91) were confronted with the

VOC emissions resulting from the maximum VOC limits provided by CEPE (column 2 ofTable 91).

The estimations were all made on EU-27+2 aggregate level. Therefore, the resulting reduction potentials needed to be distributed among countries. This exercise was accomplished applying information in total sector activities for the EU-25 Member States. These data was extrapolated to EU-27+2 aggregate level using population data from EuroStat for each of the regarded years. Data on sector activities for the four additional countries was derived from the share of population for each of this country in the EU-27+2 total populations. These results are summarised in the table below.[62]

From the table it can be seen that the highest reduction potential arises for the MTFR scenarios in 2020. Furthermore, a negative reduction potential is reported for the comparison of VOC emissions from the CEPE/DECOPAINT proposal and the average VOC limit values provided by CEPE (scenario a)). This negative value results from the fact that for some of the sub-categories presented in Table 91 (multi-pack finishes, tank linings and solvent-based intumescent coatings) the VOC limit values of the proposal are above the currently reported average VOC limit values.

[62] For the estimations of the reduction potential an emission factor of 0.95 was applied. Thus, not all of the VOC content is emitted but 5% of the VOC are assumed to remain in the container and are not released into the air. This factor is based on an agreement of experts during the compilation of the German emission inventory.

Table 91: Reduction potentials for option 9 per country

country	2010		2015		2020			
	Scenario a) kt	Scenario b) kt	Scenario a) kt	Scenario b) kt	Scenario a) kt	Scenario b) kt	Scenario c) kt	Scenario d) kt
Austria	-0.009	0.044	0.008	0.062	0.003	0.051	0.179	0.227
Belgium	-0.011	0.056	0.011	0.079	0.004	0.065	0.228	0.290
Bulgaria	-0.007	0.036	0.007	0.051	0.002	0.041	0.145	0.184
Cyprus	-0.002	0.008	0.001	0.011	0.000	0.009	0.032	0.040
Czech Republic	-0.022	0.107	0.023	0.167	0.007	0.139	0.484	0.615
Denmark	-0.085	0.418	0.078	0.577	0.025	0.458	1.600	2.033
Estonia	-0.004	0.019	0.004	0.030	0.001	0.025	0.087	0.110
Finland	-0.011	0.056	0.011	0.078	0.003	0.064	0.225	0.286
France	-0.047	0.231	0.044	0.323	0.014	0.268	0.935	1.188
Germany	-0.009	0.044	0.008	0.061	0.003	0.051	0.177	0.225
Greece	-0.011	0.051	0.010	0.072	0.003	0.060	0.208	0.265
Hungary	-0.011	0.054	0.011	0.083	0.004	0.069	0.242	0.308
Ireland	-0.006	0.027	0.005	0.038	0.002	0.032	0.110	0.140
Italy	-0.034	0.166	0.031	0.233	0.010	0.193	0.674	0.856
Latvia	-0.003	0.015	0.003	0.024	0.001	0.020	0.070	0.089
Lithuania	-0.004	0.019	0.004	0.029	0.001	0.024	0.085	0.108
Luxemburg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Malta	-0.002	0.011	0.002	0.017	0.001	0.014	0.049	0.063
Netherlands	-0.021	0.102	0.019	0.142	0.006	0.118	0.411	0.523
Poland	-0.045	0.221	0.046	0.343	0.015	0.285	0.997	1.267
Portugal	-0.006	0.030	0.006	0.041	0.002	0.034	0.120	0.152
Romania	-0.021	0.101	0.019	0.143	0.006	0.116	0.406	0.516
Slovakia	-0.002	0.011	0.002	0.017	0.001	0.014	0.049	0.063
Slovenia	-0.003	0.017	0.004	0.026	0.001	0.022	0.076	0.097
Spain	-0.036	0.175	0.033	0.245	0.011	0.203	0.709	0.901
Sweden	-0.011	0.053	0.010	0.075	0.003	0.062	0.216	0.275
UK	-0.052	0.254	0.048	0.355	0.016	0.295	1.029	1.308
EU-27	-0.475	2.326	0.449	3.321	0.148	2.731	9.543	12.126
Croatia	-0.004	0.021	0.004	0.029	0.001	0.024	0.084	0.106
Turkey	-0.067	0.326	0.062	0.461	0.020	0.376	1.313	1.669

10.3. Economic Impacts

10.3.1. Impact on public authorities

Member State authorities were asked to estimate the anticipated impact of the proposals relating to the inclusion of seven categories of protective coatings into the scope of Directive 2004/42/EC. Consultation responses received from Member States are shown in Table 92 below.

Table 92: Anticipated increase/decrease of surveillance and monitoring costs incurred by Member State authorities due to Option 9

Member State	Change in monitoring and surveillance cost
Bulgaria	+
Czech Republic	+
Cyprus	+
Estonia	+
Hungary	+
Greece	0
Ireland	+
Romania	+
Slovenia	+
Spain	+
Key: Member States were asked to rate the expected increase/decrease of surveillance and monitoring costs on a scale --, -, 0, +, ++, i.e. ranging between a strong reduction of the average costs to a strong increase.	

Most of the Member States that responded to consultation believe that the proposal would result in an increase in monitoring and surveillance costs, albeit this increase would be lower than 'strong.'

During consultation with Member State authorities prior to the publication of the interim report for this study, two Member States (Austria and Belgium) supported the inclusion of protective coatings into the scope of Directive 2004/42/EC. In addition, a total of four Member States reported having experienced problems due to the exclusion of protective coatings from the scope of the Directive (these Member States included Belgium, Denmark, Finland, Slovenia) while 18 Member States reported not having experienced any problems. Thus, it is possible that some Member State authorities may see reduced administrative burden if the proposal did succeed in eliminating problems experienced by these Member States.

10.3.2. Capital investment and stranded assets (manufacturers)

According to CEPE, the cost of investing into additional production equipment is estimated to be minimal. This is due to the fact that most manufacturers are said to already have equipment for the production of compliant products. However, manufacturers would incur costs due to the need for reformulation of existing products and testing and approval of new products. Overall, CEPE notes that the protective coatings sector would have to reformulate a "large and important part" of existing products with all companies having to reformulate at least some of their coatings.

AVNH provided expert estimates of the costs that would be incurred by paint manufacturers in the Czech Republic. These estimates are based on the experience gathered in the course of the implementation of existing provisions stemming from Directive 2004/42/EC. The results are detailed in Table 93 below.

CEPE has contacted AVNH to receive details of the estimation. As AVNH did not provide a method consolidating the estimation, CEPE considers the cost data "subjective estimates with a significant extent of uncertainty". [Warnon, 2009]

Table 93: Estimated costs incurred by manufacturers of protective coatings

Type of cost	Cost incurred by producers in CZ (€ million)	Estimated costs incurred throughout EU-27[1] (€ million)
Reformulation	1.15 - 1.8	117.3 - 183.6
Testing and re-approval	0.75	76.5
Cost of advertising new products	0.75	76.5
Stranded assets	0.8 - 1.2	81.6 - 122.4
Total	3.45 - 4.5	351.9 - 459
Sources: AVNH (July 2009), Eurostat Pocketbooks: Key figures on Europe 2007/2008. Notes: 1) Extrapolated from data on the Czech Republic based on GDP (current price) data from Eurostat Pocketbooks		

Table 93 gives estimated costs incurred by Czech manufacturers of protective coatings due to the proposal and indicative extrapolation of this data onto the EU-27.

However, it should be noted that the above extrapolation does not take into account any potential differences between the Czech Republic and other Member States. CEPE commented that the "extrapolation of the Czech data to the whole European area cannot be correct" and does "not recommend extrapolating data from a small national market to the whole EU-27". [Warnon, 2009]

10.3.3. Impact on competitiveness and trade in relation to commerce with non-EU countries

CEPE estimates that the impact of the measure on imports and exports would be minimal but some companies may need to expand their product ranges to include both compliant products for supply within the EU and non-compliant products for markets outside the EU. However, CEPE notes that this assessment is based on the proposal being limited to on-site applications. However, should such limitation not be included in the legislation, CEPE believes that it is possible that items not coated on-site may be processed outside of the EU and imported rather than processed within the EU.

10.3.4. Impact on functioning of the internal market and competition

CEPE envisages “very slight” impact on start-up costs for new market entrants due to an expected increased cost of raw materials and an increase in processing costs.

10.3.5. Impact on conduct of businesses, impacts across supply chain and SMEs

Impacts on operating costs

Several anticipated impacts on paint manufacturers have been highlighted by CEPE, including the following:

- higher solids products will require more expensive raw materials leading to higher production costs;
- higher solids products imply higher viscosity and as such the dispersion of pigments is more difficult leading to longer processing times and associated higher costs (such as energy costs); and
- new products will necessitate lower application rates (volume per area) which is likely to result in lower paint consumption thus reducing economies of scale in the manufacturing process.

However, no quantification of the degree of these impacts was attempted by CEPE.

It was noted by CEPE that manufacturers would incur costs due to product withdrawal and re-labelling but this cost burden could be minimised by means of a transition period for the measure coming into place. The length of such a period is suggested to be two years, with a one year transition period deemed too short. However, the costs of such label changes could be minimised by harmonising these requirements with those introduced by the Classification, Labelling and Packaging Regulation, due to come into force for mixtures in June 2015.

AVNH expects a negative impact on profitability of companies with knock-on effects on exports and employment, in particular employment in small companies.

Impacts on SMEs

SMEs are likely to be affected to a different degree by some of the expected impacts and CEPE's suggestion to delay the coming into force of the proposal is based on their consideration of impacts on SMEs.

However, SMEs are generally not expected to be affected by the cost of product re-approval as few SMEs participate in segments of the market where customers chose products from approved lists only. [63]

10.3.6. Impacts on consumers and professional users

It is expected that the price of protective coatings will increase but due to the characteristics of compliant paints, it will be possible to apply lower paint vol-

[63] However, it should be noted that SMEs will still have to comply with ISO, NORSOK and other standards.

umes. However, it is not clear whether this will only mitigate or wholly off-set the impact that price increase will have on end-users.

According to CEPE, a minority of professional end-users are expected to need additional equipment and the price of such equipment is given as between less than € 12,000 to over € 30,000. Possibly the greatest impact that the measure may have on end-users is related to the fact that end-users will have to learn to use compliant products which may be more difficult to apply as a thin layer (where higher solids products are used). This training relates mainly to learning the technique of applying the product efficiently.

In addition, some compliant products may be slower drying which may have an impact on the productivity of professional users. Durability of products is not expected to be affected.

Due to associated costs, AVNH expects a reduction of consumer choice with worst case scenario seeing 20 - 30% of current production not complying with the proposed limits and not being replaced with compliant products.

10.3.7. Impacts on specific countries/regions

No impacts specific to particular Member States or regions are expected, with the exception of CEPE noting that SMEs in some new Member States may experience a disproportionately negative impact and this needs to be accounted for in determining the date of entry into force of the proposal.

10.4. Social Impacts

10.4.1. Health impacts

The implementation of the option will result in a reduction of anthropogenic VOC emission which may result in a marginal reduction of average ground level ozone concentration in EU-27, Croatia and Turkey. As described before for option 9 four VOC-reduction scenarios have been considered (i.e. Scenario a), Scenario b), Scenario c) and Scenario d) with different approaches and VOC reduction potentials. In the following two tables, Table 94 and Table 95, the modelled effects on human health due to this change in the air quality are shown. For the calculations average meteorological conditions and the 2020 reference emission scenario have been used. The figures in the table take into account that the VOC reductions within EU-27+2 will also change the exposure of population in neighbouring countries (total Europe, EMEP grid). By considering only the impacts within EU-27 and Croatia/Turkey the externalities will decrease. E.g. for 2020 and Scenario b) the avoided external costs are €406,000.

Table 94: Health benefits in 2015 due to reduction of VOC emissions related to ground level ozone reduction

		2015	
		Scenario a)	Scenario b)
Reduced external costs	[€_00][64]	90,141	665,953
Mortality	YOLL	0.645	4.763
Morbitity RHA, ages over 65	cases	0.36	2.7
MDR, ages 18-64	days	1,457	10,762
RMU by adults	cases	529	3,909
RHA = cases of restricted hospital admissions; MDR = restricted activity days RMU = cases of respiratory medication use, YOLL = Years of Life Lost			

Table 95: Health benefits in 2020 due to reduction of VOC emissions related to ground level ozone reduction

		2020			
		Scenario a)	Scenario b)	Scenario c)	Scenario d)
Reduced external costs	[€_00][65]	29,584	547,443	1,912,638	2,430,498
Mortality	YOLL	0.212	3.916	13.68	17.384
Morbitity RHA, ages over 65	cases	0.12	2.22	7.74	9.84
MDR, ages 18-64	days	478	8,847	30,909	39,278
RMU by adults	cases	174	3,214	11,228	14,268
RHA = cases of restricted hospital admissions; MDR = restricted activity days RMU = cases of respiratory medication use, YOLL = Years of Life Lost					

10.5. Environmental Impacts

10.5.1. Changes in the Ground Level Ozone Concentration

The reduction of VOC emissions may reduce the ground level ozone concentration in Europe. The correlation between the VOC emission reduction and ozone concentration is a non-linear and it is influenced by a number of parameters, e.g. the NO2 background concentrations and the meteorological conditions have a relevant impact on the processes. The region or country where the VOC emissions are reduced have as well a relevant impact on the European wide changes in the ozone concentration.

The impacts of option 9 and the four VOC-reduction scenarios on the ground level ozone concentrations are shown in the following table. For the calculations average meteorological conditions and the reference emission scenario for

[64] The monetary values reported in this table are expressed in Euro on the basis of the value of the Euro in the year 2000. The estimation of the monetary values expressed in Euros of 2000 enables a comparison of the monetary values estimated for 2015 and 2020.

[65] The monetary values reported in this table are expressed in Euro on the basis of the value of the Euro in the year 2000. The estimation of the monetary values expressed in Euros of 2000 enables a comparison of the monetary values estimated for 2015 and 2020.

2020 have been assumed. The impacts of the option have been assessed for the years 2015 and 2020.

Table 96: Impact of option 9 on the average ground level ozone concentration within EU-27 + Croatia and Turkey.

	Average O3 concentration [ppb]	
	changes in [ppb]	percental changes
Scenario a)		
2015	< 0.001	< 0.001%
2020	< 0.001	< 0.001%
Scenario b)		
2015	< 0.001	0.001%
2020	< 0.001	0.001%
Scenario c)		
2020	0.001	0.004%
Scenario d)		
2020	0.001	0.005%

The ozone reduction may contribute to prevent part of the production losses due to crop damage. The benefit of the VOC reduction due to the scenario a) of option 9 has been quantified for 2015 to €42,460 and for 2020 to €13,948. The benefit as calculated by the VOC-reduction scenario b) of option 9 was quantified to be €316,689 for 2015 and €258,098 for 2020. Finally, for the option c) and d) referring to the MTFR scenario for 2020, the benefit was estimated to €901,735 and €1,145,886, respectively.

10.6. Summary of Impacts

Table 97: Option 9: Summary Impact Assessment

Stakeholder Impact	Manufacturers	Professional Users Consumers	Member State Authorities
Economic			
Capital/investment costs	-	-	
Operating costs	-	-/?	
Product and raw material prices	-	+/-	
Imports/competitiveness	0		
Competition	-		
Entry costs	0		
Product performance	0	0	
Monitoring/Surveillance costs			+/-
Social			
Employment	-/?	0	
Health			
Environmental			
Cross media	0		
Waste and recycling			
Fuel consumption vehicle emissions	+/?		
Use of renewable/non-renewable resources			
Key: 0 = no impact +/- = uncertain impact positive or negative -/? = likely slightly negative impact but unquantifiable due to lack of data + = Positive impact ++ = Strongly positive impact - = Negative impact -- = Strongly negative impact			

Annex 11

11. Adhesives – Technical background information (Option 11)

11.1. Information collection on adhesive product types and related VOC emissions

Information on all kind of adhesive systems, related VOC content and resulting VOC emissions has been described extensively in an EU-wide study:

- "Screening study to identify reductions in VOC emissions due to the restrictions in the VOC content of products" by AFC/BiPRO/DFIU, commissioned by the European Commission in 2002 [EC, 2002][66].

In addition, a study commissioned by the Dutch ministry of environment of an earlier date has been identified [CREM, 2000].

The EC-2002 study covers EU-15, taking basic data of 1999.

The industry association FEICA was asked for support with statistical sales data, as well as data on the average VOC content of the different product groups. FEICA has provided statistical data resulting from a data collection among member associations, has submitted a 'position document' [FEICA, 2008a] (Annex 47), as well as comments on options proposed by the consultants for further assessment [FEICA, 2009a] (Annex 48) and has delivered input on technical specifications of alternatives to solvent-based adhesives [FEICA, 2009b] (annex 50).

Furthermore, the project team has collected information from individual manufacturers of adhesives, from users' associations and from Member States.

Additional data collection was undertaken by REC in Central and Eastern European Member States, Croatia and Turkey (see annex 59 on page A-413).

11.1.1. Description of adhesive product groups

An adhesive is "a compound that adheres or bonds two items together" [FEICA/ASC, 2008]. The product group of 'sealants' is closely related to adhesives. Sealants are "soft, pliable materials that are used to seal cracks or joints where structural strength is not required [FEICA/ASC, 2008]. As most sealants are solvent-free or have a very low solvent content, the information collection was focussed on adhesives.

The product group 'adhesives' is maybe one of the most very versatile product groups. There is not standard classification of adhesive types. Various classifications are used simultaneously. The major classifications are based on:

- market segments (e.g. construction, consumers/DIY, footwear);
- type of substrate to be bonded (paper, metals, wood, concrete, etc.);

66 see http://ec.europa.eu/environment/air/pdf/paint_solvents/2002_02_bipro_final_report.pdf

- resin type (acrylates, epoxy, polyurethane, phenolformaldehyde, starch, cement, etc.);
- type of 'matrix', or 'drying type' (e.g. waterbased dispersions, solvent-based, hotmelts, reactives).

The classifications are not straightforward, as for example practically all types of resins can be found in water-based as well as solvent-based and hotmelt adhesives. Also, many different types of adhesives can be found in each market segment and at each type of substrate.

The European and US industry associations FEICA and ASC have issued a 'classification manual' of adhesives and sealants. The FEICA-classification into product categories uses the 7 main categories with **39** subcategories. The number of specified sub-subcategories exceeds **62**. Table 98 shows the classification into 7 main product types.

Table 98: Classification of adhesives in 7 main product types

Main product category	No. of subcategories
1. Adhesives based on natural polymers	3
1. Polymer dispersions/ emulsion adhesives (water-based)	8
2. Hot melt adhesives	8
3. Solvent based adhesives	8
4. Reactive adhesive systems	6
5. Adhesives based on water-soluble polymers	6
6. Other adhesives	1

[FEICA/ASC, 2008]

This FEICA/ASC manual distinguishes 7 main market segment categories (also used in the EC-2002 study) with no less than 33 subcategories and more than **110** 'sub-subcategories' of market segments for adhesives. For the collection of statistical (market segment) data, FEICA uses these 7 main categories. Table 99 presents the 7 market segments.

Table 99: Classification of adhesives according to the 7 main market segments

Main segment	No. of sub-segments
1. Paper, board and related products	7
2. Transportation	7
3. Footwear and leather	2
4. Consumer/ Do It Yourself (retail)	1
5. Building/ construction/ civil engineering/craftsmen	3
6. Woodworking and joinery	4
7. Assembly operations and other	9

[FEICA/ASC, 2008]

When collecting VOC emission data, a distinction between adhesives used under 'uncontrolled' conditions and adhesives used inside of installations covered by the scope of Directive 1999/13/EC should be made.

The EC-2002 [EC, 2002] study states:

“Regarding the described sectors, bonding in ‘Paper, board and related products’ and ‘Transportation’ is considered to take place exclusively in installations, whereas applications in the ‘Building, construction, craftsmen’ and ‘Consumer/ Do It Yourself’ sectors occur completely outside installations. The share of adhesives used in installations in the remaining sectors is unknown, so all input for these sectors is considered not to be covered by Directive 99/13/EC”.

Adhesives based on natural polymers include vegetable adhesives such as starch-based products, protein adhesives (e.g. casein) and ‘animal’ adhesives (e.g. bone adhesives). Generally, these products are solvent-free. Their market share is relatively low (see chapter 11.1.2).

Polymer dispersions and emulsion adhesives are water-based. They have very low solvent content (< 5% or much lower). Subtypes include e.g. acrylics, vinyl acetate copolymer (e.g. ‘wood adhesives’) and water-based polyurethanes.

Hot melt adhesives are solvent-free adhesives, which are plasticized by heating, and subsequently bond the substrate when they cool down and solidify. Various types of (thermoplastic) resins are used for hotmelts, such as polyolefins, polyesters and polyurethanes.

Solvent based adhesives include various types of products, such as polychloroprene (‘contact adhesives’), polyurethane, acrylics and silicones. Their solvent content shows a wide range, from about 10-15% for some polyurethanes up to almost 100% for PVC-adhesives used in the ‘cold welding’ process of PVC-pipes. Solvent-based adhesives are responsible for by far the largest share of VOC emissions within the product group of adhesives (chapter 11.1.2).

Reactive adhesive systems involve products that cure by a chemical reaction. Both 1-pack and 2-pack reactive adhesives exist. Generally, one-pack reactive adhesives cure by chemical reaction with moisture (water) in the air. Examples are 1-pack polyurethanes and MS-Polymer adhesives, which for example are used in the installation of wooden flooring. Two-pack products cure after adding a separate hardener component. Well-known examples are 2-pack epoxies (with amino-hardeners), 2-pack polyurethanes (with isocyanate hardeners) and 2-pack acrylics (with peroxide hardeners). Generally, reactive systems are low in VOC (up to 10%) or even VOC-free.

Adhesives based on water-soluble polymers include for example polyvinyl-alcohol and cellulose based products. Their market share is very low, just like that of the category of 'other' adhesives [FEICA, 2008a].

11.1.2. VOC emissions from adhesives

In this study, market statistics (i.e. data of product sales/consumption) have been combined, if possible, with data on average VOC content per product category, to arrive at an estimate of the total VOC emission and at separate VOC emissions per product group. For other product groups, data on VOC content of product groups was available (e.g. for cosmetic product groups and cleaning products), but however, was not available for adhesive product types.

In the following chapters, data from three sources have been used and compared to make estimates of VOC emissions due to the use of adhesives:

- 'top-down' market data of the solvent manufacturers [ESIG, 2008a];
- industry statistics from the European Adhesives Association [FEICA, 2008b], [FEICA, 2009c], [FEICA, 2009d];
- estimates made in the European Commission's study [EC, 2002].

The emission factor for adhesives is assumed as 100 %, meaning that all VOC contained in the adhesives will evaporate upon use.

11.1.3. Top-down estimates by ESIG

The website of ESIG presents a 'cake diagram' on the total use of solvents and its distribution among various sectors. Based a total solvent use of 4200 kt it is stated that 6 % is used in adhesives, i.e. **252 kt** [ESIG, 2008a]. ESIG has explained that this data refers to EU-15 and 2005 [ESIG, 2008b]. An extrapolation to EU-27 data results in the use of **318 kt** of solvents for adhesives applying the population ratio (1.265). ESIG has highlighted that this data includes non-VOC solvents.

11.1.4. FEICA statistics

FEICA has provided statistical data on the base year 2007, covering EU-27. These data are available as a split-up in the 7 main categories of product types. More detailed data on sub-categories are not available.

Moreover, they cover sealants as well (which however have very low VOC contents generally). Thus, the data can be used to make a rough estimate. Table 100 presents the outcome, resulting in 241 - 424 kt of VOC content in EU-27.

Table 100: Adhesive and sealant consumption and VOC content estimates for EU-27 in 2007

Main product category	Use (kt)	VOC (%)*	VOC (kt)
1. Adhesives based on natural polymers	252	-	-
2. Polymer dispersions/ emulsion adhesives (water-based)	1292	1-2%	13 – 26
3. Hot melt adhesives	347	-	-
4. Solvent based adhesives	378	50-85%	189 – 321
5. Reactive adhesive systems	756	5-10%**	38 – 76**
6. Adhesives based on water-soluble polymers	95	1%	1
7. Other adhesives	32	-	-
total	3150		241 – 424
*rough estimates (industry data & expert judgement), **mainly reacting inside the product and not emitted			

based on [FEICA, 2008a], [FEICA, 2008b]

FEICA states that solvent-based adhesives account for "more than 80% of the total solvent usage" [FEICA, 2008a] [FEICA, 2008b]. It has to be considered that a relevant share of adhesives is used inside of installations under controlled conditions (e.g. self-adhesive tape production).

Taking into account that the major part of VOC contained in reactive adhesives will not emit, VOC contained in water-based and solvent-based systems are **286 – 489 kt in 2007**. However, the upper range is resulting from the maximum assumptions of the above table for solvent-based adhesives (average VOC content 85 %) can therefore be regarded as a ´worst-case´ estimate. Part of this VOC is completely emitted under 'uncontrolled' conditions, and part of it is used under 'controlled' conditions (in installations covered by Directive 1999/13/EC) where part of it may be destroyed.

11.1.5. Estimates in the EC-2002 study

In the study of ATC/BiPRO/DFIU [EC, 2002], the total VOC emission due to the use of adhesives was estimated with 220 kt for 1999 in EU-15, originating from:

- Solvent-based adhesives: 200 kt (average VOC-content 48%);
- Water-based adhesives: 16 kt (average VOC-content 1.4%);
- Thinners and primers: 4 kt.

Compared with FEICA data, an additional category (´tape production´) is listed. In the FEICA data on 2007, this market segment has been included in the segment of ´Paper, board and related products´.

By means of industry consultation, the EC-2002 report estimated a split up of the adhesive consumption and VOC emissions over the 7 main market sectors for both **solvent-based** and **water-based** adhesives. In addition, the share of ´uncontrolled´ emissions (not covered by Directive 1999/13/EC) was estimated.

Table 101: Estimated VOC content in solvent-based adhesives and uncontrolled emissions in EU-15 in 1999

Main product category	VOC (kt) total	VOC (kt) uncontrolled
1. Paper, board and related products	30	0
2. Transportation	30	0
3. Footwear and leather	15	<15
4. Consumer/ Do It Yourself (retail)	10	10
5. Building/ construction/ civil engineering/craftsmen	20	20
6. Woodworking and joinery	15	<15
7. Assembly operations and other	15	<15
8. Tape production	60	0
Total	195	30 – 75

[EC, 2002]

Table 102: Estimated VOC content of water-based adhesives and uncontrolled emissions in EU-15 in 1999

Main product category	VOC (kt) total	VOC (kt) uncontrolled
1. Paper, board and related products	5	0
2. Transportation	<1	<1
3. Footwear and leather	<1	<1
4. Consumer/ Do It Yourself (retail)	<1	<1
5. Building/ construction/ civil engineering/craftsmen	6	6
6. Woodworking and joinery	3	3
7. Assembly operations and other	<1	<1
8. Tape production	<1	<1
total	± 16	± 11

[EC, 2002]

Based on these estimates, the 'uncontrolled' share of VOC emissions from water-based and solvent-based adhesives is 20 - 41 % of the total VOC content. The VOC emission sums up with **41 - 86 kt** for 1999 in EU-15.

Based on the population ratio between EU-15 and EU-27 (factor 1.265), total VOC in solvent-based adhesives are 247 kt, with **38 - 95 kt** 'uncontrolled' VOC emissions. For water-based adhesives it is assumed that 100 % is emitted under 'uncontrolled' conditions, equivalent with **14 kt VOC**. Total VOC in water-based and solvent-based adhesives are 267 kt, whereof 'uncontrolled' VOC emissions result in **52 - 109 kt** in EU-27.

11.2. Summary of VOC emission data of adhesives

Extrapolating data of EU-15 of the EC-2002 study data leads to total VOC amounts in water-based and solvent-based adhesives of **267 kt** for EU-27.

Based on FEICA data for EU-27, VOC content in water-based and solvent-based adhesives is **203 - 348 kt in 2007**. The comparision shows good consistency of data.

Solvent-based adhesives contain about 247 kt VOC in EU-27 (extrapolated from 1999, EU-15) or, based on FEICA data for 2007, about 189 – 321 kt.

As the upper range is calculated with worst-case scenario data, for the distribution of solvent-based adhesives into the sectors of adhesive use, the mean value of the range is used: 255 kt for EU-15 by the EC-study [EC, 2002]. Table 101 above shows 195 kt of VOC, which can be extrapolated to an amount of **247 kt** of VOC contained in solvent-based adhesives (reflecting an average VOC content of 68 %).

Table 103 presents the resulting estimates of VOC emissions from solvent-based adhesives for EU-27, split up by sectors. For the calculation, data from the EC-2002 study was extrapolated with a fix population ratio between EU-15 and EU-27 (factor 1.265), assuming that neither the relative *distribution* over the market segments nor the relative *shares* of ´uncontrolled emissions´ have changed, and moreover, that the market *segments* are similar in EU-15 and EU-27.

Table 103: Estimated VOC content in solvent-based adhesives and uncontrolled emissions in EU-27 in 2007

Main product category	VOC (kt) total	VOC (kt) uncontrolled
1. Paper, board and related products	38	0
2. Transportation	38	0
3. Footwear and leather	19	<19 (10?)
4. Consumer/ Do It Yourself (retail)	13	13
5. Building/ construction/ civil engineering/craftsmen	25	25
6. Woodworking and joinery	19	<19 (10?)
7. Assembly operations and other	19	<19 (10?)
8. Tape production	76	0
Total	247	38 –95 (68)

based on [EC, 2002] [FEICA, 2008a]

As result, 'uncontrolled' emissions from adhesives sum up with **at least 38 kt** of VOC in EU-27 only from the two categories 4 and 5 (Consumer/ Do It Yourself and Building/construction/civil engineering/craftsmen).

Uncontrolled emissions from solvent-based products could sum up with 95 kt, depending on the amount of solvent-based products used in 'uncontrolled' conditions in the groups "footwear and leather", "woodworking and joinery" and "assembly operations and other".

European Member States reported uncontrolled VOC emissions of 1473 kt in EU-27 in 2006 (category 3D, ´Other solvents´) [EEA, 2008a].The above calculated amount of **38 – 95 kt** of 'uncontrolled' VOC emissions from solvent-based adhesives represents a share of **2.5 - 6.5 %** of the VOC inventory category 3D, with the upper percentage considered as worst-case. Additionally, **about 14 kt** VOC emissions originate from water-based adhesives, representing a share of **1 %** of the category 3D emissions.

11.3. VOC reduction options and reduction potential

In adhesives, VOCs mainly have the role of ´solvent´, which in turn means that they fulfill several functions [EC, 2002] [FEICA, 2008a]:

- They reduce the viscosity of the adhesive, enabling an easy and economic (thin layers) application;
- They adapt (either increase or, with water-based sometimes decrease) the drying time
- They reduce the need for pretreatment of the surface (e.g. degreasing with solvents).

Solvents are able to evaporate from two relative impermeable surfaces, in contrast to water. Therefore, in certain areas, solvent-based adhesives cannot be substituted by water-based adhesives [FEICA, 2008a]. However, it ha to be remarked that chemically reacting adhesives (low VOC or VOC-free) may be suitable in some of these cases. According to industry, considerable VOC reductions have been achieved already in adhesives, thus limiting further reduction potentials [FEICA, 2008a]. According to industry, in particular in the following applications, solvent-based systems should not be restricted, because no feasible alternative would exist. According to the consultants, the arguments below seem to be reasonable.

- *Primers*: in certain applications these are needed to pretreat the surface. They are applied in very small quantities, thus limiting VOC reduction potential. Besides, primers enable the use of low-VOC waterborne or reactive systems in some cases.
- *Pipe adhesives* (for PVC-pipes); also called: ´PVC-adhesives´. These are used in a very specific process which involves bonding PVC-pipes together by means of ´cold welding´: high VOC adhesives partly dissolve the PVC, thus enabling a seamless weld. Amounts used are very low.
- *Spraying adhesives*: This is a very small niche application, which involves complicated shaped subjects, which are sprayed with very thin layers of aerosol-type adhesives. Because of the low volumes used and the complexity of substitution, these products may remain unregulated.
- *Shoe repair adhesives*: in shoe repair shops, high speed of repair (e.g. sole fitting) is of major importance. Generally, high-VOC contact adhesives are still used. Moreover, different types of ´substrates´ are offered, which all have to be bonded quickly and very firmly.

11.3.1. Reduction options - general

However, in selected areas in which solvent-based adhesives are applied in ´open´ processes, significant reductions are considered possible by shifting from solvent-based to waterborne and chemically reactive systems. In agreement with FEICA, the consultants propose to focus on current applications of **solvent**-based adhesives as only by substituting certain applications of this product type significant reductions may be achieved. As mentioned, the VOC emissions from ´open´ applications of solvent-based adhesives most probably range between 38 and 95 kt (EU-27).

At an earlier stage of the project, a regulation on the VOC content of adhesives that exists in the United States was considered. Although the regulation is very detailed, distinguishing many product types and VOC-limits, there are various barriers hindering the adoption of this specific regulation:

- The VOC-definition in the US is different from the VOC-definition used in the EU. In particular, relevant solvents (e.g. acetone) are exempted in the US.
- The regulation contains categories of adhesives not known in the EU;

- The regulation contains many specialty applications of adhesives, which concern applications in industrial installations;
- The regulation specifies very many product categories, some of which concern very low volumes of use.

11.3.2. Reduction options – proposal ´flooring adhesives´

One area, in which VOC reduction may be significant and feasible, is the application of solvent-based adhesives in bonding various types of floor coverings:

- ´soft` floor coverings, such as carpet, cork, vinyl etc.
- ´hard` floor coverings, i.e. parquet in various types: massive wood, laminates, plywood ´underfloors` etc.

This activity is an ´open` application in which large surfaces are covered by the adhesives. It is part of the market segment "Construction, building, civil engineering, craftsmen" and ´Consumers/DIY`", for which total uncontrolled VOC emissions have been estimated above with 25 kt. Detailed VOC data collection of FEICA of 21 Member States and extrapolation to EU-27 (based on population ratio) has resulted in total VOC emissions of **22.6 kt** from solvent-based flooring adhesives in 2007, assuming an average VOC content of 40 %, except for UK and Germany, where detailed figures were available [FEICA, 2009c], [FEICA, 2009d] (see chapter 12.1.1 on page 136).

In The Netherlands, a national regulation on floor covering adhesives is in place since January 2000 [Noordam, 1998]. The regulation covers only *indoor* bonding activities. However, outdoor bonding of floor coverings will most probably be a negligible activity. The Dutch regulation sets VOC-limits for adhesives used in bonding both soft and hard flooring materials, including any ´pretreatment´ products (e.g. leveling products and watersealing primers). Only one general VOC-limit has been specified, which is:

5 g/kg (0.5%).

As this limit is very low, the implication is, that only waterborne or solvent-free, chemically reactive adhesives can be used or so-called ´not in kind´ alternatives, such as mechanical fixation or the use of double-sided tapes. Currently, one or more of the following products or other options are used as substitutes for the VOC-based adhesives (the so-called ´alcohol adhesives´):

- Waterborne dispersions: various types exist, e.g. with varying solids content;
- 1-pack polyurethanes (moisture-curing);
- 2-pack polyurethanes (isocyanate-curing);
- 1-pack MS-Polymer adhesives (moisture-curing);
- Double-sided tapes, nails etc. (in particular in bonding soft floor coverings on stairs).

Although some ´start-up problems` occurred after introducing the regulation, flooring installers (carpet and parquet layers) have been working with the alternatives for a couple of years now. No major problems have occurred, although in particular the bonding of soft floor coverings on stairs made the definition of careful work practices necessary. Generally, for each type of floor covering and each type of substrate, a specific low-VOC solution that provides satisfactory results is available. Moreover, in many cases the alternatives appear to perform better than the ´old´ high-VOC adhesives – in particular because most of them are more ´flexible´. However, detailed guidance on which products to choose for which specific application appeared to be necessary [Terwoert, 2005].

Detailed information is available on the feasibility of low-VOC adhesives in these areas and on ´good practices` while using these alternatives. A summary of this information is provided in Annex 52.

Based on the relevant VOC reduction potential of about 22.6 kt and stimulated by the positive experience in The Netherlands, the project team has assessed the option of setting a VOC limit value of 0.5 % as a potential amendment of Directive 2004/42/EC. For this option, a detailed impact assessment was undertaken (see option 11 in the subsequent annex chapter 12).

Annex 12

12. Solvent based flooring adhesive – Impact Assessment (Option 11)

12.1. Description of the Option and Background Information

Option 11 involves the inclusion of solvent-based floor-covering adhesives into the scope of Directive 2004/42/EC, defining a maximum VOC content for this product group with 5 g/kg (0.5%).

The product group 'solvent-based floor covering adhesives' comprises a variety of products. A definition of the product group is given in EN 923:2006 (' Adhesives - Terms and definitions') under number 2.1.7:

Solvent-borne adhesive; solution adhesive; solvent based adhesive
Adhesive in which the binder is dissolved in a volatile organic solvent
(Note: in practice solvents used for solvent-borne adhesives have boiling points below 170 °C at 101,3 kPa and a vapour pressure greater than 50 Pa at 20 °C and, if flammable, a flashpoint below 55 °C.)

A number of consultees (e.g. FEICA, BASA) have commented on this definition and have highlighted their preference for this definition if the product group of solvent-based floor covering adhesives is considered to be included in Directive 2004/42/EC [FEICA 2008c] (see Annex 49). This would avoid discussions on a level of the VOC furthermore allowed in floor covering adhesives, and would simply target a specific adhesive system, requiring its complete substitution by alternative adhesive systems.

The project team considers the proposal of stakeholders as equivalent with the above mentioned option 11 because the substitution effect for solvent-based flooring adhesive systems would be the same. It is not proposed to take up the informative note of EN 923:2006 because Directive 2004/42/EC defines VOC with a boiling point < 250°C at 101,3 kPa. For the aim of the option, it is clear and unambigous to refer to the definition of the adhesive system described by EN 923: "*Adhesive in which the binder is dissolved in a volatile organic solvent".*

12.1.1. Background Information: Current Market and Impact of the Option

First estimations of 'uncontrolled' VOC emissions from solvent-based adhesives have been made when developing the option (see previous annex chapter 11.1.2). The result shows 'uncontrolled' VOC emissions from adhesives of **at least 41 kt** in EU-27 from market segment categories 4 and 5 ('Consumer/ Do It Yourself' and 'Building/construction/civil engineering/craftsmen'), and maximum VOC emissions of 101 kt depending on the 'uncontrolled' use of solvent-based adhesives in other market sectors.

To support the assessment of option 11 on solvent-based adhesives, FEICA has undertaken additional efforts of VOC data collection. The association was confronted with major difficulties due to inconsistant statistical data in the different countries and lacking information on VOC-related data.

Table 104 presents data on current usage of solvent-based flooring adhesives obtained from national manufacturers' associations in Germany and in the UK (IVK and BASA). It shows a similar share of solvent-based adhesives in both countries if tiling adhesives are not considered.

Table 104: Flooring adhesives markets in Germany and in the United Kingdom in 2008

	DE				UK			
	Data including tiling adhesives		Data excluding tiling adhesives		Data incl. ceramic floor tiling adhesives		Data excl. ceramic floor tiling adhesives	
	Share	Use [kt]	Share	Use [kt]	Share	Use [kt]	Share	Use [kt]
Total annual use (kt)	100%	250	100%	72.5	-		100%	36
Solvent-based (% of above)	2%	5	7%	5	-		8%	2.9
Polymer dispersions/emulsions (% of above)	12%	30	41%	30	-		-	
Reactive systems (% of above)	15%	38	52%	38	-		-	
Tiling adhesives (% of above)	71%	177			-			

Sources: IVK and BASA

Notes: IVK provided market data including tiling adhesives while BASA provided data excluding adhesives for ceramic floor tiles. Data for Germany is for 2008 and data for the UK is current and as such consultants assume that it also relates to 2008.

Table 105 shows results of the data collection of FEICA for category 5, which has a high overlap with floor covering adhesives.

Table 105: Solvent-based adhesives of the category "Building Construction, Civil Engineering, Craftsmen"

	2004		2007	
Country	Total amount [kt]	Value [MM€]	Total amount [kt]	Value [MM€]
Austria	1.10	3.96	1.02	4.05
Benelux	3.52	12.67	3.40	13.45
France	14.40	51.84	14.05	55.65
Germany	18.36	66.10	18.03	71.38
Great Britain	13.00	53.82	12.88	58.67
Italy	9.00	32.40	8.67	34.33
Nordic countries	1.77	6.37	1.62	6.41
Spain/Portugal	5.20	18.72	5.08	20.10
Switzerland	1.00	3.60	0.93	3.69
Other countries (*)	1.08	3.89	1.04	4.14
Sum	68.43		66.72	

(*) Others are: Baltic states, Cyprus, Ireland, Greece, Malta Slovenia

[FEICA, 2009d]

Detailed VOC data on flooring adhesives was provided by the British and the German adhesives associations. For other countries without specific VOC data, FEICA assumed an average VOC content of 40 % in category 5 products.

Table 105 was evaluated as following to obtain VOC related data: Data of Germany and UK was not counted (providing specific VOC data), neither data of Switzerland (non-EU country), thus reducing the total amount of adhesives in 2007 to 34.88 kt. Assuming 40 % VOC content, the total VOC emission in the remaining 19 EU Member States is **14 kt**, missing data of Bulgaria, Czech Republic, Hungary, Poland, Romania and Slovakia. The population ratio between the 19 Member States and the missing 6 Member States was calculated (350.1 MM vs. 257.0 MM) resulting in VOC emissions of **19 kt**.

BASA estimated the annual UK market of floor covering adhesives to be a maximum of ~36 kt. Of this a maximum 8 % (2.88 kt) is estimated to be solvent-based adhesives. For total VOC emissions, BASA calculated with a worst case scenario (VOC content of 80 %, ~800 g/l), resulting in a total VOC emission of **2.3 kt**. It noted that the data does not include adhesives for ceramic floor tiles.

Table 106 shows data of Germany, having an average VOC content of 25 %, resulting in **1.3 kt** of VOC emissions from solvent-based flooring adhesives.

Table 106: Solvent-based flooring adhesives in Germany in 2007/2008

	Textile floorings and linoleum	Parquet floorings and hard wood	Precoating, primers, neoprene	Total
Total amount [t]	178	4423	492	5093
Total VOC [t]	26.7	884.6	344.4	1256
Averge VOC	15 %	20 %	80 %	25 %

[FEICA, 2009c]

When adding the above mentioned specific VOC data of UK and Germany to the above calculated 19.0 kt of VOC, the resulting **total VOC emissions from floor covering adhesives are ~22.6 kt in EU-27 in 2007.**

This data was used for the calculation of the VOC reduction potential and the resulting reductions of ozone formation, see annex below chapter 12.2.

12.1.2. Trends in Use of Solvent-based Flooring Adhesives

In **The Netherlands**, a national regulation on floor covering adhesives was adopted in 2000 [Noordam, 1998]. The regulation aims at improvement of occupational health, demanding compliance with a general VOC limit of 5 g/kg (0.5%) for *indoor* adhesive activities regardless whether bonding soft or hard flooring materials. The limit also covers pretreatment products (like for levelling).

No major problems have been reported. However, in particular the bonding of soft floor coverings on stairs required the definition of careful work practices; guidance on appropriate product selection was useful (see annex chapter 0).

In 2009, 18 adhesive manufacturers and suppliers have signed a convenant with the Dutch parquet flooring associations (CBW, VPL, VPVB) to start a campaign ("Holland VOC free") that shall promote the use of parquet flooring adhesives complying with the 0.5 % VOC limit. The initiative aims at ceasing the use and the marketing of solvent-based parquet adhesives.[67] At present, only one major producer is not participating in the campaign (Lecol).[68]

In **Germany**, the national adhesives association IVK estimates that in the late 1980s the ratio of solvent-based and water-based systems was approximately equal (1:1). Since the late 1980, IVK notes that various initiatives[69] on occupational health, indoor air quality and environmental protection have resulted in a relevant decline in the use of solvent-based adhesives, the actual ratio of solvent-based and water-based systems being 1:7, accounting solvent-based systems for ~2% of flooring adhesives (including reactive and tiling adhesives).

In addition, it was noted by the parquet and flooring layers association in Germany (ZVPF) that a natural process of reduction in the use of solvent-based flooring adhesives is taking place based on generational differences in floor layers' attitudes, with younger floor layers being comparatively more aware of issues relating to occupational health and environmental protection.

In the **UK**, it was noted by BASA that the consumption of solvent-based flooring adhesives has undergone a declining trend. Market innovation and environmental initiatives are set to further decrease future use of solvent-based flooring adhesives, until the only solvent-based products that will remain available are those for "very specialist and high performance applications."

However, in relation to the **EU-27**, IVK expects that in a scenario with no legislative intervention, the use of solvent-based flooring adhesives is set to increase in the future. This will be mainly due to the absence of relevant occupational health and environmental legislation in some countries, in particular in the new EU Member States but also in some old Member States. It was noted that, without legislative control, solvent-based adhesives have many advantages vis-

[67] see CBW information (in Dutch): http://www.cbw.org/view.cfm?page_id=9260

[68] The following, internationally operating suppliers have signed the agreement: Bona, Bostik, CéPé, Van Kesteren/Dicol, Grosema/Woca, Henkel/Thomsit, Kerakoll/SLC, Osmo, Overmat / Floorservice, Renotec Duo / Eucula, Rubio Monocoat, Soudal, Stauf , Unipro/Pallman, Ursa Paint/Aquamarijn, Tremco Illbruck, Zettex

[69] see e.g. the EMICODE classification system to improve indoor air quality: http://www.emicode.de

à-vis alternative adhesive systems as they are easy to manufacture, easy to use and they are less expensive.

12.1.3. Stakeholder suggestions for Changing the Proposal

Two consultees (FEICA and BASA) have made suggestions for amendment of the proposed option, mainly due to the fact that they would prefer the focus of the option to be defined by using the EN 923:2006 standard and that there is a need to establish exemptions for applications where alternative adhesive systems do not provide comparable performance.

FEICA forwarded a number of suggestions for amendment of the proposal. These suggestions relate to the following issues:

- placing a limit value of 5 g/kg on VOC content in solvent-based flooring adhesives amounts to the withdrawal from the market of this product group while alternative flooring adhesive systems with higher (initial) VOC content are not affected (such as reactive systems where the major share of solvents does not emit to ambient air but reacts within the product). FEICA expects that this may lead to criticism of alternative systems. A potential solution includes absence of the VOC limit value and definition of the focus of the option in accordance with the definition of solvent-based adhesive systems in number 2.1.7 of EN 923:2006;
- according to FEICA, alternatives to solvent-based adhesives are designed for use in the typical interior conditions with temperatures around 20ºC and low humidity; therefore it is recommended by FEICA to restrict the applicability of the proposal to non-humid environments at 20ºC;
- in some applications where fast-drying is needed, in particular where an initial tack is not available or where substrates are not air-permeable, FEICA argues that alternative adhesive systems would not provide performance comparable with solvent-based adhesives, and thus there is a need to establish exemptions from the proposal for certain applications, including curved floorings, skirting and cove bases and other curved surfaces, and rubber or PVC baseboards, homogenous-heterogeneous PVC, cushion vinyl and non-porous substrate, such as metal.

The project team agrees with the first suggestion and acknowledges the climatic disadvantages of non-solvent-based systems, although althernative systems are applicable if ambient conditions are not extreme (see chapter 12.3.3 below). To evaluate the necessity of exemptions, an in-depth study on the experience of Dutch professional floor layers may be executed. Evaluations of the project team in The Netherlands have not revealed unresolvable problems.

12.2. VOC and ozone reduction potential

12.2.1. Availability of data

FEICA provided data on the size of the market for solvent-based flooring adhesives from 21 Member States; missing data was extrapolated via population ratio. Furthermore, data for Germany and the UK have been regarded separately, because national organization, IVK in Germany and BASA in the UK, were able to provide detailed data for solvent-based floor adhesives.

For all countries an average VOC content of 40 % was assumed by FEICA except for Germany and UK because of detailed data. Following FEICA, for UK 80 % VOC content was assumed, and for Germany 3 different VOC contents (15 %, 20 % and 80 %) related with data of 3 types of solvent-based adhesives.

Considering all these informations, a total amount of VOC emission of **22.6 kt** has been estimated from solvent-based adhesives in 2007 in EU-27.

12.2.2. Approach of projection for scenarios in 2015 and 2020

Two scenarios for the future years 2015 and 2020 have been examined to assess the impacts of the VOC emission reduction related to the above option.

In order to develop these scenarios, data provided by FEICA for 2004 and 2007 on VOC emissions of solvent-based adhesives were extrapolated into these future years. The factor used for the extrapolation was assumed to be an annually constant growth rate based on the given development between 2004 and 2007. The formula of the so-called compound annual growth rate (CAGR) enables the estimation of a constant annual growth rate for a given initial and final value.

12.2.3. Estimation of reduction potentials

The scenarios are based on the proposal to introduce a VOC limit value for solvent-based flooring adhesives of 5 g/kg (0.5%), equivalent with a complete substitution of solvent-based products by alternative adhesive systems like water-based, reactive or hotmelt floor-covering adhesives.

For the scenarios it has been assumed that the solvent-based adhesives are substituted by the same amount of flooring adhesives containing 0.5 % VOC. The substitution of products containing 40 % VOC to products with 0.5 % VOC is equivalent to a VOC emission reduction of 80 %.

Based on data of 2007 assuming 22.6 kt of VOC emitted in EU-27, the introduction of the option could potentially reduce VOC emissions by 22.2 kt, remaining total VOC emissions of 0.4 kt from substitution products with a maximum VOC content of 0.5 % after the implementation of the new VOC limit.

A distribution of the total reduction potential among Member States of EU-27 was accomplished to allow for country specific impact assessments of resulting VOC emission reductions. Furthermore, an extrapolation of EU-27 data to EU-27+2 data was done in order to include Croatia and Turkey into the analysis.

The extrapolation to EU-27+2 aggregate level was estimated applying the ratio of population data for EU-27 and EU-27+2 using data provided by EuroStat.

The distribution of the total VOC reduction potential to each country was also calculated using national population data provided by EuroStat. VOC data for Germany and the UK was not estimated with the ration of population data because data was made available by the national associations IVK and BASA.

The above described distribution of reduction potentials among EU-27 Member States plus Croatia and Turkey has been accomplished for the years 2015 and 2020. Table 107 summarises the reduction potential for each of the countries and presents the total VOC emission reduction potential for the EU-27.

The difference to the 22.6 kt VOC estimated for 2007 results from the application of the Compound Annual Growth Rate, estimated on base of data for 2004 and 2007. As this growth rate represents a slightly decreasing market for floor covering adhesives, the reduction potentials also decrease for 2015 and 2020.

Table 107: VOC emission reduction potential in EU-27+2 resulting from substitution of solvent-based floor covering adhesives (option 11)

Country	2015	2020
	kt	kt
Austria	0.41	0.40
Belgium	0.53	0.52
Bulgaria	0.36	0.33
Cyprus	0.04	0.04
Czech Republic	0.51	0.48
Denmark	0.27	0.26
Estonia	0.06	0.06
Finland	0.26	0.25
France	3.10	3.00
Germany	1.20	1.15
Greece	0.55	0.53
Hungary	0.48	0.45
Ireland	0.24	0.25
Italy	2.94	2.81
Latvia	0.11	0.10
Lithuania	0.16	0.15
Luxemburg	0.03	0.03
Malta	0.02	0.02
Netherlands	0.81	0.77
Poland	1.84	1.73
Portugal	0.53	0.51
Romania	1.02	0.95
Slovakia	0.26	0.25
Slovenia	0.10	0.09
Spain	2.38	2.34
Sweden	0.46	0.45
UK	2.13	2.04
EU-27	20.79	19.95
Croatia	0.26	0.25
Turkey	4.14	3.97

The expected VOC emission reduction of about 20 kt per year equals a share of 1.3 % of current VOC emissions in category D ('Other solvent use'), reported for 2006 from EU-27 Member States [EEA, 2008a].

12.3. Economical Impacts

12.3.1. Impact on Manufacturers

Table 108 below details the numbers of manufacturers of solvent-based flooring adhesives in Germany and the UK, and indicates the proportion of manufacturers (where known) which are SMEs. It also indicates the number of manufacturers that would be affected by the proposal and highlights that there may be very few manufacturers that rely exclusively on production of solvent-based adhesives and that, where known, the proportion of companies that are SMEs is relatively high in this sector (around 90%).

Table 108: Number of manufacturers supplying various types of flooring adhesives

	Column A		Column B		Column C	
Adhesive Type	Number of manufacturers of flooring adhesives		% of manufacturers in Column A that are SMEs		% of manufacturers in Column A that are also engaged in production of adhesives for non-flooring applications	
	DE	UK	DE	UK	DE	UK
Only solvent-based	-	2-3				
Only other types1	-	4-5				
Both solvent-based and other	70	4-5	> 90%	90%	30%	80%
Total	70	12				

Sources:
BASA, IVK
Notes:
All data given are approximate.
1) 'Other' refers to the following adhesive types: polymer dispersions and emulsions, reactive systems, hot melts, water-soluble polymers, natural polymers, other.

IVK does not expect that the proposal would require additional investment by adhesives manufacturers in Germany, while BASA expects UK manufacturers to incur additional (unquantified) investment costs due to changes in manufacturing facilities and in educating end-users.

Imports and exports seem to account for only a very small proportion of production in Germany and the UK. Following the introduction of the proposed limit, German and British SMEs are expected to discontinue exports while large companies in Germany are expected to relocate some production activity (BASA and IVK).

In all likelihood, the measure would not lead to any manufacturers leaving the flooring adhesives sector in Germany (IVK). In the UK, most companies have a portfolio across various technologies and as such cessation of operation as a consequence of the proposal is unlikely. However, it was noted that SMEs are likely to be most adversely affected as they tend to be more specialised than larger companies (BASA).

12.3.2. Impact on Suppliers

According to IVK and BASA, implications across the supply chain due to diminished demand for solvents are not expected to be significant.

12.3.3. Impact on Professional Users

FEICA and BASA expect that the measure would lead to a completely substitution of solvent-based flooring adhesives by other adhesive systems and non-adhesive fixing solutions (such as nailing and floating flooring).

However, FEICA and BASA propose that certain types of flooring applications are exempted from this proposal as no alternatives with comparable performance would exist. Applications proposed as exemptions include those not undertaken in typical indoor conditions (20 ºC and low humidity), those on substrate that is not air-permeable and those where immediate tack is needed (the list of proposed exemptions can be found earlier in this chapter). BASA notes that alternatives, such as water-based systems, necessitate impractical drying times and adhesive tapes do not offer adequate durability; aerosol products would also suffer from 'inferior performance' (not further specified).

However, as stated earlier, using combinations of double sided tapes (initial tack) and water-based contact adhesives (durability of the bond) may provide satisfactory results [Terwoert, 2005], although labour time may increase.

The impact of temperature and humidity on drying time and average drying times of various adhesive systems is specified in Table 109 and Table 110.

Table 109: Impact of temperature and humidity on drying (curing) time of various adhesive types

Type of adhesive	Impact of temperature on curing time (High-medium-low)	Impact of humidity on curing time (High-medium-low)
Solvent-based	Low	Low
Polymer dispersions and emulsions	High	High
Reactive systems	Medium/high (medium) [1]	Medium/high (medium) [1]
Hot melts	Medium/high	Medium/high
Natural polymers	High	High
Water-soluble polymers	High (medium) [1]	High (medium) [1]
Other	Medium/high	Medium/high
Source: Consultation responses by IVK, BASA Notes: 1) Source is SPP only.		

Table 110: Average drying (curing) time of flooring adhesives on different materials (in hours if not indicated otherwise)

Floorings Adhesive types	Wooden	Carpet	Vinyl	Cork	Elastomer	Linoleum	Laminate
Solvent-based	24 (72)[1]	12				12	
Polymer dispersions and emulsions	4-7 days	24	24	24	24-36	24	
Reactive systems	4-5 (24) [1]	4-5			4-5	4-5	4-5
Hot melts	0				0	0	
Natural polymers	4-7 days	4-7 days	4-7 days	4-7 days		4-7 days	
Water-soluble polymers	4-7 days (3 days) [1]						
Sources: ZVPF (German Parquet and Floor Layers Association) unless specified otherwise Notes: All drying times at 18-20 ºC and 50 % humidity unless indicated otherwise [1] Source of information is SPP (no information on temperature and humidity given)							

FEICA elaborated on the functional disadvantages of alternatives to solvent-based systems as follows:

- the use of water-based systems is dependent on achieving indoor conditions (18-20ºC room temperature, 15ºC floor temperature and 65-75% humidity);
- reactive systems are also said to be impacted by low temperatures and humid conditions and are seen as not offering the same degree of initial grab as solvent-based systems;
- the use of hot-melts for flooring applications is uncommon in most countries due to difficulties associated with their application.

It is of note that, in the Netherlands, a limit of 0.5 % for interior use of flooring adhesives is in place for the past few years, effectively substituting solvent-based flooring adhesives, and consultants are not aware of any large-scale problems caused by the limit to the floor laying industry. Similarly, floor layers' associations in Germany and Poland (ZVPF and SPP) note that alternatives to solvent-based flooring adhesives offer satisfactory performance in all applications.

These discrepancies may be explained by different level of substitution in EU Member States but may also result from varying building practices, which includes climatic conditions (temperature, humidity) under which floors are laid.

ZVPF noted that, in Germany, flooring work is always carried out in conditions of typical room temperature while BASA stated that building practices in the UK are significantly different from other countries to the degree that the proposal would have a significantly greater negative impact on the UK. This is due to the fact that in the UK flooring work in new buildings is carried under non-heated conditions and therefore adequate performance at a low temperature is needed. In addition, remedial work in public buildings (schools, hospitals, etc.) tends to be carried out when these are closed to the public (such as at night, even where the building is to re-open the next day) and when the heating is not switched on. In addition, BASA stated that in some applications, such as those in schools and hospitals, solvent-based systems would have to be used for performance reasons (alternative systems would suffer from shrinkage, plasticiser resistance, gapping). Similar problems have not been reported from the Netherlands where solvent-based adhesives need to be substituted at any interiors.

In the consultation, stakeholders raised several issues in relation to the productivity of professional users, including the fact that the alternatives to solvent-based flooring adhesives, such as dispersion and reactive adhesives, may be more complicated to use, there may be limitations on which materials they may be used on, drying times may be slower and their durability may be shorter. The consultants assume that these problems may be solved with increased experience with the alternative adhesive systems as major difficulties have not been reported in the Netherlands where a substitution is in place.

12.3.4. Impacts on Member State authorities

Member State authorities were requested to assess the expected impact of the proposals relating to flooring products on monitoring and surveillance costs. The results are summarised in Table 111.

Table 111: Anticipated increase/decrease of surveillance and monitoring costs incurred by Member State authorities due to Option 11

Member State	Change in monitoring and surveillance cost
Bulgaria	+
Czech Republic	+
Cyprus	++
Estonia	+
Hungary	+
Greece	0
Ireland	+
Romania	+
Slovenia	0
Spain	+
Key: Member States were asked to rate the expected increase/decrease of surveillance and monitoring costs on a scale --, -, 0, +, ++, i.e. ranging between a strong reduction of the average costs to a strong increase.	

In summary, most Member States that provided a response believe that the proposed option would bring about an increase in monitoring costs but not at a strong level. The Irish authorities noted that initial familiarisation with the product and the market and the relevant distribution costs will be required but potential increased costs are anticipated to be relatively low.

12.4. Social Impacts

12.4.1. Health impacts

The implementation of the option 11 will result in a reduction of anthropogenic VOC emission which may result in a marginal reduction of average ground level ozone concentration in EU-27, Croatia and Turkey.

As described above, only one VOC-reduction scenario has been considered for 2015 and 2020. Table 112 shows the modelled effects on human health due to this change in the air quality. For the calculations average meteorological conditions and the 2020 reference emission scenario have been used. The figures in the table take into account that the VOC reductions within EU-27+2 will also change the exposure of population in neighbouring countries (total Europe, EMEP grid). By considering only the impacts within EU-27 and Croatia/Turkey, the externalities are lower; e.g. for 2020 the avoided external costs are €3,165,000.

Table 112: Health benefits in 2015and 2020 due to reduction of VOC emissions related to ground level ozone reduction

		2015	2020
Reduced external costs	[€_00][70]	4,472,000	4,293,000
Mortality	YOLL	31.99	30.70
Morbitity			
RHA, ages over 65	cases	18.11	17.38
MDR, ages 18-64	days	72,268	69,372
RMU by adults	cases	26,252	25,200
RHA = cases of restricted hospital admissions; MDR = restricted activity days and RMU = cases of respiratory medication use, YOLL = Years of Life Lost			

12.5. Environmental Impacts

12.5.1. Changes in the Ground Level Ozone Concentration

The reduction of VOC emissions by about 20 kt may reduce the ground level ozone concentration in Europe. The correlation between the VOC emission reduction and ozone concentration is a non-linear and it is influenced by a number of parameters, e.g. the NO_2 background concentrations and the meteorological conditions have a relevant impact on the ozone formation processes. The region or country where the VOC emissions are reduced have as well a relevant impact on the European wide changes in the ozone concentration.

The impacts of option 11 on the ground level ozone concentrations are shown in the following table. For the calculations average meteorological conditions and the reference emission scenario for 2020 have been assumed. The impacts of the option have been assessed for the years 2015 and 2020.

Table 113: Impact of option 11 on the average ground level ozone concentration within EU-27 + Croatia and Turkey.

	Average O3 concentration [ppb]	
	changes in [ppb]	percental changes
2015	0.003	0.009%
2020	0.002	0.008%

The ozone reduction may contribute to prevent part of the production losses due to crop damage. The benefit of the VOC reduction due to the proposed amendment of Directive 2004/42/EC by substitution of solvent-based floor covering adhesives (option 11) has been quantified for 2015 to €2,028,000 and for 2020 to €1,950,000.

[70] The monetary values reported in this table are expressed in Euro on the basis of the value of the Euro in the year 2000. The estimation of the monetary values expressed in Euros of 2000 enables a comparison of the monetary values estimated for 2015 and 2020.

12.6. Summary of Impacts

Table 114 provides a summary of the main impacts of Option 11.

Table 114: Floor Covering Adhesives (Option 11) - Summary of Impacts

Stakeholder / Impact	Manufacturers	Professional Users	Member State Authorities
Economic			
Capital/investment costs	-/?	-/?	
Operating costs		-	
Product and raw material prices			
Imports/exports	-/?		
Competition	0		
Innovation/research	0		
Product performance/productivity		-	
Monitoring/Surveillance costs			-
Social			
Employment	-	0	
Health			
Environmental			
Cross media	0		
Waste and recycling	0		
Fuel consumption vehicle emissions	0		
Use of renewable/non-renewable resources	0		

Key:
0 = no impact
+/- = uncertain impact positive or negative
-/? = likely slightly negative impact but unquantifiable due to lack of data
+ = Positive impact
++ = Strongly positive impact
- = Negative impact
-- = Strongly negative impact
Note:
Member State monitoring costs refer to Options 12a, 12b and 12c being adopted simultaneously.

Annex 13

13. Cosmetics – Technical background information (Option 12)

13.1. Information collection on cosmetic products

VOC emissions due to the use of cosmetic products have been covered in a few studies, the following being the major ones:

- a screening study commissioned by the European Commission [EC, 2002];
- a study commissioned by the Dutch ministry of environment [IVAM, 2005].

The latter study comprises data of The Netherlands and Belgium. The EC-2002 study covers EU-15, using data of 1999.

The European cosmetics industry association Colipa has been contacted in order to explore their potential to provide statistical data, as well as data on the average VOC content of the various products. In response, a detailed technical briefing paper on deodorants/antiperspirants and hairsprays was received [Colipa/FEA 2008c] (annex 54). Furthermore, detailed comments responding the impact assessment questionnaire were submitted. In addition, data was provided by several individual manufacturers of different size.

Additional data collection was undertaken by REC in Central and Eastern European Member States, Croatia and Turkey (see separate REC report).

13.1.1. Description of the product group

The product group of cosmetics contains a large variety of product types. Various classifications are used. Table 115 presents the classification in main categories that the European association of cosmetics manufacturers Colipa uses in their market statistics, as well as the number of subcategories included in these categories. In total, **44** subcategories are distinguished. However, even within each subcategory, various product groups exist. E.g., subcategory 3.6, “Baby care products” contains “creams, lotions and milks”, and subcategory 4.6 in main category ‘hair care’ contains “hair creams, brillantine, hair gels ***etc***”. Therefore, the total number of “product types” as indicated in the Colipa categorization, appears to be *at least* ***115***. Annex 53 presents the complete survey of subcategories and product types within, as distinguished by Colipa.

Table 115: Colipa main categories of cosmetic products

Category	No. of subcategories
I. Perfumes and fragrances	7
II. Decorative cosmetics	5
III. Skin care	8
IV. Hair care	10
V. Toiletries	14
Total	*44*

[Colipa, 2008a]

The study of IVAM [2005] arrived at a selection of 28 cosmetic product sub-categories *that contain VOC* and thus were selected for further study. These categories were determined in close cooperation with the Dutch association of cosmetics manufacturers (NCV). The category data have been used for making new estimates for EU-27, because Colipa collects statistical data only at the aggregated level of the 5 main categories.

13.1.2. VOC emissions due to cosmetic products

In order to present an estimate of the total contribution of cosmetic products to VOC emissions in Europe, as well as the individual contributions of the product types, information collection is needed on:

- Statistical data on the use and/or production, per product type;
- The average VOC content per product type;
- The emission factor for each product type.

These aspects will be shortly discussed. Subsequently, the results of the various ways of making VOC emission estimates will be presented.

Statistical (market) data

It has become clear that statistical data on volumes or tonnages of products produced or consumed are neither collected at the EU level (Colipa), neither at the national level in most Member States. However, Colipa and the associations ***do*** collect data in terms of *'total sales in euro*' (Retail Sales Prices' and 'Manufacturer Sales Prices') as well as *per capita consumption in euro*. Unfortunately, generally these figures are only available on the aggregated level of the 5 main categories.

However, more detailed national figures had been available for the Netherlands for the first estimate. These were collected by IVAM – in cooperation with the national association – and entail figures on 'tonnages' used [IVAM, 2005]. With a number of assumptions these literature data had been used for first extrapolation to the level of the EU-27, by means of comparing 'per capita' consumptions in the various Member States, based on assumtions on retail selling prices, average VOC content and emission factors.

During the second phase of the project, in their briefing paper and reaction on the interim report, Colipa/FEA have provided estimates of product consumption and VOC emissions based on industry data and expert judgement [Colipa/FEA, 2008] [Colipa/FEA, 2009a]. These have been used to improve the initial estimates and to calculate the resulting benefits.

Average VOC content per product type

VOC in cosmetics are primarily used as propellants for delivering the product (in aerosols), as (co-)solvents, as preservatives and as fragrances. In terms of volumes, propellants and solvents are the predominant uses. Propellants are liquefied gases that are used to push the product out of the spray can, to maintain an even pressure within the spray can (providing a continuous, even spray pattern) and to break up the aerosol into a droplet size which is sufficiently fine to achieve the required performance. Frequently used propellants include propane/(iso-)butane mixtures and dimethylether. In some cases, pentane or isopentane are used.

Solvents are primarily used to dissolve and/or mix ingredients, to adjust the viscosity of the product, and in some cases to enable fast drying. Major solvents used in cosmetic products are ethanol and isopropanol, but many others are used as well.

The VOC content of the various product types shows a wide range, with aerosol type products on the upper end (90 – 95 %) and products such as shampoos and tooth paste on the lower end (1 – 3 %). Detailed information on the average VOC content of the various product types is hard to find, partly because this is sometimes regarded confidential information. In some case, only ranges or even 'maximum' values can be found. Besides, presented averages sometimes cover more than one product type.

For example, in the IVAM report [2005], industry data on the average VOC content of 'roll-on' deodorants/antiperspirants are presented (31 %). However, two types of roll-on deodorants/antiperspirants exist: alcohol-based products with an average VOC content of about 60 % and emulsion-type products with an average VOC content of less than 2 %. Additional input from Colipa on the market shares of the various product types has been received.

Emission factor per product type

In contrast to paints and varnishes and e.g. adhesives, not the entire VOC content of cosmetic products will evaporate. In fact, for aerosol-type cosmetic products practically all of the VOC *will* evaporate, but for so-called 'rinse-off' products, such as shampoos, part of the VOC will end up in the sewage system.

Depending on the degree of water solubility (which is high for e.g. ethanol) part of that solvent will not evaporate from the water system, and consequently, will not reach the atmosphere. To account for this type of effects, emission factors (< 1) may be defined per product type. In the study of IVAM [2005] these emission factors have been defined (see Annex 24). They have been used in the current study again. The emission factors assumed in this study have been presented in annex 24.

7.8.2.1 Estimate of VOC emissions

A detailed inventory of the Dutch market prepared in 2005 [IVAM, 2005] has been used to arrive at a first, rough estimate of total VOC emissions of cosmetic products in the EU – and of VOC emissions per product group. These have been further developed.

The above-described assumptions have been used for first assumptions, as well as Colipa statistics of ´per capita´ consumption of cosmetic products (in euro´s). In addition, the EUROSTAT number of inhabitants in EU-27 has been used, as presented in the Colipa statistics 2007 (1 January 2007: 494,429,000, not including Cyprus and Malta) [Colipa, 2008a].

The estimate has been prepared for the first rough calculation as follows:

Product consumption EU-27 *(kt)

$$= \text{product consumption NL (kt)}^{**} \times \frac{\text{average per capita consumption EU-27}^{*}}{\text{Per capita consumption NL}} \times \frac{\text{inhabitants EU-27}^{*}}{\text{inhabitants NL}}$$

= product consumption NL x 22,0

* without Malta and Cyprus ** from [IVAM, 2005]

Table 116 presents the results of this calculation. A few remarks on this table:

- The base year for all data is 2007.
- The number of inhabitants for EU-27 used is 494,429 million (not including Cyprus and Malta as in [Colipa, 2008a], for the Netherlands 16,365 million.
- The average per capita consumption of cosmetic products for the EU-27 (without Cyprus and Malta) is 115 euros, and for the Netherlands 158 euros [Colipa, 2008a].
- The average VOC content per product group was obtained from the Dutch association [IVAM, 2005], but the average VOC content of the pump-spray type of hairsprays was corrected, from 35% to 80%, in agreement with industry [Colipa, 2009b]. If no date were available, only product consumption is presented;
- As stated above, an average VOC content of 31 % was assumed for the roll-on type of deodorant, which is a combination of two subtypes: alcohol-type rollers with approximately 60 % VOC and emulsion-type rollers with less than 2 % VOC. The market share of each subtype is not available.
- All figures have been rounded at 2 digits;
- The final VOC emission figured were corrected for 90 % market coverage of the association members and 10 % addition for ´professional products´ that are used in hairdressing and beauty salons.

In the second project phase, Colipa provided detailed input on VOC average content of hairspray and deodorants/antiperspirants as well as total amounts. These data have been inserted into the table and also used for later calculation of the VOC reduction potential and related benefits.

Total VOC emissions from the use of cosmetic products for the EU-27 has been calculated with **293 kt** (base year 2007). Relative to the 3D category of VOC emissions ('Other Solvents') of 1473 kt (2006 data [EEA, 2008a]), the contribution of cosmetic products is 20 %.

Most contributing product groups are deodorant/antiperspirant aerosols with 39 % (113 kt) and hair spray aerosols with 34 % (101 kt), together producing 73 % of total VOC emission from cosmetics.

Compared with category 3D emissions in EU-27, the sum of aerosol hair sprays and deodorants/antiperspirants contribute with **15.2 % (224 kt)** to this category.

The alcohol-type roll-on deodorants/antiperspirants contribute with 0.7 % (2.1 kt) to total VOC emissions from cosmetics and the roll-on emulsion-type deodorants/antiperspirants with 0.5 % (1.4 kt).

Table 116: Outcome of VOC emission estimate for cosmetic products

Product category	Product use (kt)	Maximum VOC content (%)	VOC use	Emission factor*	VOC emission incl. professional products
Shampoo/conditioner	399				0.3
Shampoo	315	1	3.5	0.05	0.2
Conditioner	26	2	1.8	0.05	0.1
Hair styling products	*297*				*123*
Hair spray (total)	*112*		*106*		*101*
Hair spray (aerosol)[$]	*109*	*95*	*103*	*0.95*	*98*
Hair spray (pump)	*3.3*	*80-95*	*3.1*	*0.95*	*2.9*
Styling foam	36	*6-10*	2.9	1	2.9
Styling gel	149	*13*	2.1	0.85	19
Hair dye	24				1.1
Permanent dye cream	9.5	0	0	0.85	0
Permanent dye liquid	7.3	10	0.9	0.85	0.7
Semi permanent cream	1.5	0	0	0.85	0
Semi permanent liquid	1.5	10	0.2	0.85	0.2
Direct dye	2.2	0	0	0.85	0
Dye mousse	1.1	7	0.1	0.85	0.1
Dye strenghtener	0.2	40	0.1	0.85	0.1
Soap, bath and shower product	591	5	33	0.05	1.5
Deodorant / Antiperspirant	*175*				*130*
Aerosol[$]	*124*	*95-97*	*119*	*0.95*	*113*
Roll-on alcohol type	*4*	*55 (40-70)*	*2.3*	*0.95*	*2.1*
Roll on emulsion type	*26*	*6 (3-10)*	*1.5*	*0.95*	*1.4*
Pump	*13*	*90*	*11*	*0.95*	*11*
Stick	*6*	*43 (35-50)*	*2.5*	*0.95*	*2.3*
Creams	*2*	*6 (3-10)*	*0.1*	*0.95*	*0.1*
Hand & body care	116	5	6.4	0.85	5.9
Hand care	22				
Body care	94				
Face care	63	15	11	0.85	9.9
Cleansers	32				
Moisturizers	26				
Sun cosmetics	23	10	2.6	0.85	2.2
Tooth paste	106	3	3.5	0.05	0.2
Shaving product	44	15	7.5	0.50	4.2
Aftershave	6.8	60	4.6	0.85	4.0
Perfume	11	80	9.7	0.85	8.1
Nail polish	4.0	80	3.1	0.85	2.9
Nail polish remover	?		-		-
TOTAL	*1860*			*335*	*293*

Data in italic was updated with Colipa input in the second project phase [Colipa/FEA, 2009b], [Colipa/FEA, 2009c]

* VOC emission factor reflects the situation that not all VOC is emitted to ambient air but partly destroyed if remaining in waste container or disposed in the sewage system.

13.1.3. VOC reduction options and reduction potential

Because of the large number of product types (> 115) it will be impossible to define and enforce a VOC limit for each of them. Besides, given the limited relevance of many product types in terms of VOC emissions, any regulation should focus on those types that contribute the most and/or allow cost efficient reduction options. In this respect, the two product groups 'hair sprays' and 'deodorants/antiperspirants' have the largest shares, each contributing about 7 % to the total VOC emissions from uncontrolled product use (3D). In addition, ´hair modelling products´ contribute close to 1.5 %. Therefore, these three product groups have been selected for further consideration below.

The considerations on VOC reduction potential of these product groups have been based on information in the studies of IVAM [2005] and ATC/BiPRO/DFIU [EC, 2002], and on discussions with industry, in meetings with Colipa (with representatives from national associations and individual companies), and one meeting with an individual company. In addition, industry has provided a 'briefing paper´, covering hairsprays and deodorants/antiperspirants, as well as detailed comments to the interim report [Colipa/FEA, 2008] [Colipa/FEA, 2009a]. These documents provide up-to-date information on:

a. current VOC contents and their rationale;

b. functions of VOC in the products;

c. product subcategories;

d. factors affecting market penetration (consumer demand, acceptance);

e. pros and cons of various low-VOC alternatives;

f. developments and trials of low-VOC options in the past.

13.1.3.1. Hair sprays

Hair sprays are mainly used to *fix* a hairstyle. Current VOC-levels of conventional hair sprays range between 90 and 95%, and consist of propellant plus solvent, and small amounts of fragrance. Its high content of propellant and solvent enables the product:

- to dry rapidly
- to generate the very fine mist which is needed for its performance
- to maintain a constant pressure and a continuous and uniform ‚cloud' at application
- to mix and/or dissolve the various ingredients, such as the resin.

The slight variations in VOC content that exist, distinguish product subtypes that are more or less rapidly drying, more or less strongly 'fixing' etc.

Reducing the content of propellant or solvent leaves the manufacturer with the challenge of finding an alternative way of dissolving and *mixing* the components and creating a *fine mist*. The particle size for a hair spray should not be larger than 75 µm [Wülknitz, 1992]. If the particle size becomes too large, hair is stuck together and feels hard ('helmet effect'). Another undesired effect from high water content in hair sprays is the 'curl droop effect', i.e. the break-up of hydrogen bonds, destroying the hair style [IVAM, 2005; Colipa/FEA, 2008]. Attempts to reduce the solvent content have resulted in the availability of [IVAM, 2005]:

a. *reduced VOC content* in the aerosol with conventional propellants,

b. alternative aerosol formulations with *compressed gas* as a propellant,

c. alternative *spraying devices* without propellant.

Ad. a – Reduced VOC content in the aerosol with conventional propellants

Reduction of the VOC emission when using conventional aerosol systems may be achieved by '*concentrating*' the product. By increasing the content of active components (e.g. the resins), the amount of product that is needed per application is reduced. The actual VOC content of the product is not reduced, but the *consumption* is, and therefore the VOC emission resulting from the amount of product used. In order to achieve this, the valve and nozzle system has to be adapted in such a way that *less* product is sprayed per unit of *time* [IVAM, 2005].

Concentrated products were available in the mid-90's, but were withdrawn again. Apparently, the main problem was the lack of consumer acceptance. In addition, the risk of blocking the nozzle increases with concentrated products. In 2000, these products were no longer available [CREM, 2000]. According to industry [Halleux & Pfeifer, 2005], adaptation of the valve and nozzle system is still a major technical bottleneck.

Another potential way of achieving VOC reduction was replacing part of the solvent by *water*. Hair sprays with a VOC content as low as 80 % have been tried on the market. However, such formulations appeared to be too 'wet', i.e. having too large droplets and being too slowly drying [IVAM, 2005].

The feasibility of hair sprays with conventional propellants and less than 90 % VOC is therefore considered low [Colipa/FEA, 2008]. Moreover, the majority of ´fixing´ hairsprays currently on the market have a VOC content of about 95%. In order to achieve a VOC content of 90% by adding water to the formulation, DME has to be used as a propellant, instead of propane/butane [Colipa/FEA, 2009a].

Ad. b. alternative aerosol formulations with compressed gas as a propellant

Compressed gas based systems use compressed gas as a propellant instead of VOC´s such as propane/butane or dimethylether. At least theoretically, these may reduce VOC in aerosol products. Prototypes of aerosols with compressed gas as the propellant have been available. Compressed gases used so far include compressed air, nitrogen (N2) and carbon dioxide (CO2). Generally, the following technical problems with compressed gas systems have been noted [IVAM, 2005] [Colipa/FEA, 2008]:

- A pressure drop in the can as a result of the fact that compressed gas is consumed. This in turn results in a discontinuous spray, which hampers an optimal performance. With conventional propellants this problem does not occur, because the liquid propellant in the can is in equilibrium with its gaseous phase, providing a continuous pressure, over the entire life-span of the product.
- Compressed gas does not provide an ´additional solvent action´, as liquid propellants do. Therefore, the content of solvent (ethanol or others) has to be raised, which severely limits any VOC reduction;
- Liquefied propellant partly escapes from the valve with the product, and evaporates rapidly from the aerosol droplets (´flashing´). This causes a further ´break-up´ of the aerosol droplets, which eventually provides the very fine, ´dry´ mist that enables optimal product performance. Compressed gas systems do not have this effect.
- In some case, the compressed gas may be incompatible with the constituents of the product. In particular, this may be the case with carbon dioxide, which lowers the pH of the product.

One has tried to tackle the latter problem by providing the compressed gas in a separate room in the spray can (the 'bag-in-can' system). Although this solves the incompatibility problem, the problem of pressure drop remains. In addition, the system is relatively expensive [IVAM, 2005].

On the other hand, the problem of pressure drop has recently been addressed by the new system that uses activated carbon in combination with carbon dioxide. The activated carbon temporarily 'traps' the gas, and releases it upon use. This would provide a continuous pressure and an even spray effect [Chemviron, 2008].

Initial research activities of the supplier of this new technology and manufacturers of hairsprays have been started. For the moment, the system has to be regarded as an 'emerging technology'. However, industry has indicated that, despite its merits for other product groups, they do not consider such a system as an ´emerging technology´ for hairsprays [Colipa/FEA, 2009a]. The lack of ´additional solvency´ power and the absence of the ´flashing´ effect (´break-up of the droplets) are regarded major disadvantages.

c. Alternative spraying devices without propellant.

This type of alternatives involves so-called ´nebulisers´ or ´finger pump` systems. The products contain neither conventional liquefied gas as propellant, nor compressed gases. However, the package contains a special spray nozzle that enables spraying. Each time the consumer presses the button, air is compressed in s small container, after which it takes care of pushing out the product and forming the aerosol. Spraying takes place in a discontinuous way. Because there is no volatile liquid propellant present, the solvent content (ethanol) has to be raised, in order to fulfil the solvent function and to reduce the particle size of the aerosol [IVAM, 2005]. Therefore, the VOC reduction potential is limited. In order to provide VOC reduction, the water content is increased. Example products with 75% solvent and 16% alcohol do exist [IVAM, 2005]. However, the performance and properties of the product are not similar to those of conventional aerosols:

- the spray is discontinuous and has to be actively maintained; therefore, application is considered more difficult;
- the spray is more ´wet` than conventional sprays, i.e. the droplets are larger and the product dries less quickly;
- as air is entrapped at each pumping action, the product´s shelf life may be shorter as a result of contaminations entering the can [Colipa/FEA, 2008].

Therefore, the product would provide less fixation (´hold`) in long hair. Nevertheless, the finger pump system is offered on the market along with conventional aerosols. Companies introduced them on the market in the early ‘90s, when discussions about CFCs raised environmental awareness. Pump sprays were offered as an alternative to CFCs. Today, as CFCs have been substituted, such products represent only about 5 % of the hairspray market EU-wide, after about 10 % in the 90s [IVAM, 2005] [Colipa/FEA, 2008]. Because of the observed disadvantages, they did not reach larger market shares. Finger pump systems are now mainly used on short hair. The aim of their use would be mainly ´styling` instead of ´fixation` [IVAM, 2005]. However, one advantage of the finger pump system is the observation that larger aerosol droplets result in less (potential) inhalation of aerosol by the user. This is mainly relevant for professional users, i.e. hairdressers [Terwoert, 2002].

Altogether, the conventional aerosol system and the finger pump system are generally not regarded as fully ´interchangeable`. The same holds for a variant technology: the so-called ´pump and spray` systems.

13.1.3.2. Deodorants and antiperspirants

The main difference between deodorants and antiperspirants is the fact that the latter contain an additional additive (aluminiumchlorohydrate) that oppresses the formation of sweat [IVAM, 2005]. Industry has provided the following definitions for the two subtypes [Colipa/FEA, 2008]:

1. "Deodorants are designed to counter malodour generated in the underarms. They can also be applied in other parts of the body to deliver the pleasant smell of the fragrances";
2. "Antiperspirants not only counter malodour generated in the underarms but also combat the wetness produced by sweat. These products should only be applied in the underarms".

Part of the discussion described under the heading 'hairsprays' also holds for deodorants. In the aerosol and pump spray types of deodorants, the functions of the solvent and/or propellants are largely similar. The same types of components are used, and the industry is faced with the same challenges when VOC reduction of aerosol sprays or pump sprays is aimed at.

However, within the product group of deodorants, additional methods of application are available, which in fact have been present on the market for a long time and still hold a considerable market share. The product types available in this product group and their current market shares in *Germany* – as provided by Colipa/FEA - are presented in Table 117. According to Colipa/FEA, EU-wide market shares are not too far from the German figures, although they may reflect a slightly higher share for roll-ons and lower for pump sprays Colipa/FEA, 2008].

Table 117: Market shares of the various types of deodorants and antiperspirants in Germany

Product type	Market share
Aerosols	63%
Roll-on (all types)	25%
Sticks and cremas	5%
Pump sprays	7%

[Colipa/FEA, 2008]

Currently, the conventional aerosol type is by far the largest contributor to VOC emissions from deodorants/antiperspirants [IVAM, 2005] because:

- the VOC content is the highest: 95 % (solvent and propellant);
- it's the most popular application type, with an EU-wide market share of 63%;
- per application, the highest amount of product is consumed.

With respect to the relative product consumption, literature has indicated various estimates of the variation in product use per application. It has been estimated that the consumption of a conventional aerosol *per application* would be *3-4 times* higher than the consumption of roll-ons or sticks. In comparison with the pump spray type ('nebulisers'), the estimates ranged from 1.5 to 3 times more consumption with aerosols [IVAM, 2005]. This aspect may be taken into account when a product regulation is considered.

The various product types, with aerosols and roll-ons as by far the most popular types, are equally offered in the market by all suppliers. In each specific product line (brand), both aerosols and roll-on are offered, and sometimes also sticks.

The relative popularity of the aerosol-type has been explained by:
[Colipa/FEA, 2008]

- its instant 'dry' sense; it does not feel 'sticky' or 'wet';
- hygienic reasons: it does not touch the skin, i.e. it can be shared with other persons as well;
- its long shelf-life, compared to roll-ons which may get contaminated;
- its use as a 'body-spray' by many consumers, instead of a spray for the armpit only.

Similar to hairsprays, attempt to reduce VOC can be made in various ways, with the alternative application devices as additional options:

a. *reduced VOC content* in the aerosol with conventional propellants,

b. alternative aerosol formulations with *compressed gas* as a propellant,

c. alternative *spraying devices* without propellant.

d. alternative application devices: *roll-ons* or *sticks*.

Ad. a. *Reduced VOC content* in the aerosol with conventional propellants

Concentration of the formula is a potential reduction option for deodorant sprays, similar to the option described for hairspray aerosols. The valve and nozzle system should be adapted, in order to reduce the amount of product sprayed per application. Similar to concentrated hair sprays, the amount of product used per task is then reduced. The potential emission reduction was roughly estimated at 15 % [IVAM, 2005]. However, similar to the hairspray case, the product has been tested, but seems to have failed so far because of the lack of consumer acceptance. One specific problem with the antiperspirant sub-type was, that 'white marks' were left on clothes as a result of the higher content of the antiperspirant ingredient [IVAM, 2005] [Colipa/FEA, 2008].

Increasing the *water content* of the formulation is another option. In fact, the introduction of deodorant sprays with ~ 80 % VOC was attempted some years ago, but failed. The higher price, as a result of shifting from propane/butane to dimethylether as the propellant, was thought to be one reason. The less 'dry' nature of the spray - contrary to consumer demands - was thought to be another reason [IVAM, 2005] [Colipa/FEA, 2008].

Ad. b. Alternative aerosol formulations with compressed gas as a propellant,

Similar objections as those stated in the chapter on hairsprays above, would apply to the option to use compressed gas systems for deodorant aerosols. However, the problem of the ‘pressure drop’ upon use may be slightly less severe in this case. One might suppose that a pressure drop does not affect the performance of a deodorant spray as strongly as it does affect the performance of a hairspray. However, because the content of solvent (ethanol) has to be increased to compensate for the solvency action of the propellant, the potential VOC reduction seems to be very limited.

Ad c. Alternative spraying devices without propellant.

Similar to hairsprays, finger pump systems are available which involve - technically - the substitution of propellant by water and ethanol, the adaptation of the valve and nozzle system and the use of HDPE or glass packages instead of aluminium [IVAM, 2005]. According to industry data, the market share of finger pump systems in Europe is only 7 % or slightly below (Table 116 on page 157).

With respect to user friendliness and consumer demands, the following aspects are relevant:

- Aerosols provide a ‘cooling’ sense to the skin at application, which is liked by many consumers; finger pumps provide this effect to a lesser extent, as they contain no propellant.
- Finger pumps do not provide a continuous spray. This point will be of less relevance than with hairsprays, but part of the consumers may find the finger pump system less user friendly.
- Pump sprays tend to contain more water than aerosols with liquefied propellants. Apparently, for a limited portion of the consumers’ nebulizers work well, but for other consumers the product is possibly too wet. On the other hand, increasing the alcohol content would not lead to a VOC reduction.
- According to manufacturers, consumers tend to stick to the brand of deodorant they have chosen once, because they like the fragrance. A shift from aerosols to finger pumps, which contain more water, changes the perception of the fragrance. The manufacturer may fear to lose loyal clients, and has to try and adapt the formulation in order to prevent losing them.

Consequently, consumer acceptance may certainly hinder this option, considering its current market share of at most 7 %.

Ad. d. Alternative application devices: roll-ons or sticks.

The potential VOC reduction that may result from stimulating a shift from aerosols to roll-ons or sticks depends on the actual type of roll-on or stick. The following types are currently on the market [IVAM, 2005] [Colipa/FEA, 2008]:

- roll-on – 'alcohol' type: ± 60% (± 600 g/l; being ethanol);
- roll-on - emulsion-type: < 2%: mainly *antiperspirants*;
- sticks: up to 50% (500 g/l); antiperspirant sticks mainly contain volatile silicone oils, or more specifically: cyclopentasiloxane (boiling point 180°C); deodorant sticks may contain ethanol or propylene glycol.

As described, aspects of user friendliness and consumer demands that are relevant in the case that a consumer should be stimulated to change from an aerosol to a roll-on are:

- fastness of drying/ no 'sticky', 'wet' sense;
- the wish to stick to the current, preferred fragrance;
- the decreased 'cooling' sense with rollers, compared to propellant type aerosols;
- the wish for 'hygiene', i.e. a product that does not come into contact with the skin of the armpit.

Alcohol free roll-ons (mainly antiperspirants) will have an even further decreased 'cooling' sense. On the other hand, roll-ons and sticks are advertised as being 'handy' (small) alternatives, which are easily to carry in a handbag. The 'alcohol-free', emulsion-type roll-ons are advertised as being 'skin friendly'. They contain emulsifiers that enable mixing the components, and high boiling alcohols such as octyldodecanol and/or glycolethers which provide adhesion to the skin [Van Yperen, 2003], In addition, they serve as skin softener, and enable the 'ball' of the roll-on to move smoothly [Van Raalte & Vollebregt, 2000]. Roll-ons and sticks contain 3 to 4 times more preservatives than aerosols and pump sprays, because transfer of microorganisms from the skin to the product takes place [IVAM, 2005].

Industry has stated that aerosol deodorants cannot be replaced by roll-ons and sticks, considering the current market share of aerosols of 63 %. The consumer apparently has a clear preference for the aerosol-type. From an entirely 'technical' perspective a shift to roll-ons and sticks has to be considered feasible: as opposed to nebulizers, there are no barriers regarding product performance in terms of their antiperspirant and/or odour controlling function. Roll-ons and sticks are effective antiperspirants because of the effective 'skin coverage' combined with the active ingredients (aluminiumchlorohydrate in the antiperspirant type, and the ethanol that acts as antibacterial agent in the 'alcohol-type').

The VOC reduction potential from a complete shift away from conventional aerosols have been estimated for the option of a VOC limit value of 10% meaning a ban of all products other than the emulsion-type roll-on (see chapter 54).

As stated before, the amount consumed per application ('functional unit') of roll-ons and sticks is thought to be a factor 3 to 4 lower than the functional unit of conventional aerosols. This might increase the VOC reduction potential. However, again, consumer acceptance may hinder this option, considering the current market share of roll-ons of 25%.

13.1.3.3. Hair styling products (gels, mousses etc.)

The product group of 'hair modelling products' has no precise definition. The category was introduced by the Dutch cosmetics producers´ association, The following description of the products and considerations on potential VOC reduction have been taken from be study of IVAM [2005].

Apart from hair sprays, which style and fixate the hair, various types of other hair styling products are available. Gels and waxes, and the subtype gelwax, have become very popular, in particular among the youth. Current VOC contents may be considerable for gels and mousses (foaming products), and much lower for creams and waxes.

Gels may typically contain 12-15% VOC (ethanol) [Colipa/FEA, 2009a]. Furthermore, they generally contain resins, fragrance, preservative and water. They may also contain some silicone (dimethicone) hair conditioners. *Hair styling mousses*, i.e. foaming products, may contain 6-10% VOC [Colipa/FEA, 2009a], being ethanol and propellants such as butane/propane or dimethylether. *Styling creams* may contain about 10 % of VOC (propylene glycol). Furthermore, styling creams may contain non-volatile components such as up to 60 % waxes, up to 20% hair conditioning agents, up to 20 % silicones (e.g. dimethicone) and up to 15 % emulsifiers. *Waxes* generally contain only the fragrance as volatile components. Because the waxes (petroleum products) have an unpleasant smell themselves, the fragrance content is relatively high: up to about 3 %, compared to 1 % for gels. The subtype gelwax will have a VOC content that is somewhere in between the VOC content of waxes (close to zero) and gels (up to 15 %). Actual data are not known.

Options for VOC reduction include reduction within the product types themselves, or a shift towards other types. Options described include:

- reduced alcohol content in gels;
- shift from aerosol-type styling mousse to non-aerosol foam dispensers
- shifts between product subtypes.

Reduced alcohol content in gels

Literature provided no data on the possibilities to reduce the alcohol content in gels. Replacing part of the ethanol with water will increase drying times and will change the styling effect. Replacing part of the ethanol with non-volatile components will do the same. Very many product varieties can be seen on the market, each being promoted for its own merits: styling, fixing (strong, super strong, mega strong, ultra strong etc.), wet look providing (achieved by adding waxes), soft touch, firm touch etc. Suppliers obviously state that these types are not exchangeable, and that limiting the VOC content will remove part of the product varieties that consumers desire. The US EPA has prescribed a VOC content limit of 6 % for gels, but this is only feasibly because ethanol is exempted.

Shift from mousses with propellant to non-aerosol foam dispensers

Non-aerosol foam dispensers have been on the market for quite some time, and are very successful in a number of product groups. These include finger pump and hand pump foam dispensers for e.g. hair styling mousses, hand soaps, bath and shower wash, shampoos, conditioners, baby soaps, sun protection foams etc. [Van der Heijden, 2004]. The foam is created by a pump that is integrated in the cap of the package. The product is mixed with air in specially designed nozzles, which may provide various types of foam. It has appeared that in the case of foaming products, consumers consider the finger pump or hand pump products as being user friendly.

The finger pump and hand pump foam dispensers will remove the liquid propellant from the product. Other than with hair sprays, this will probably not have to lead to an increase in the content of the solvent ethanol.

Shifts between product groups

Regarding the solvent content of hair styling products, roughly the following ranking order can be seen:

> Aerosol type mousses > gels > [non-aerosol mousses] > gelwaxes > creams > waxes.

Theoretically, shifting towards gelwaxes, creams or waxes would reduce the VOC emissions from the use of hair styling products. However, the various product types will probably not be regarded as ‘exchangeable’ by the consumer. It is supposed that promoting shifts like these will not be very successful, maybe with an exception for the shift from aerosol type mousses to non-aerosol mousses.

Annex 14

14. Cosmetics – Impact Assessment (Option 12)

14.1. Description of Option and Background Information (Option 12a: Introduction of a VOC limit for deodorants/antiperspirants)

14.1.1. Option 12a: Deodorants and Antiperspirants

For deodorants and antiperspirants, it was proposed to assess the impacts of introducing a 10% limit on VOC content (w/w).

Following a proposal of Colipa and FEA [Colipa/FEA, 2009a], deodorants and antiperspirants are defined as follows:

- **Antiperspirant**: product which is used to control malodour and reduce perspiration in the human axilla.
- **Deodorant**: product, with 3 % or less fragrance, which is used onto the human axilla or body to provide a scent and/or minimize odour.

14.1.2. Summary of Consultation

Consultations were conducted on the above proposal with interested stakeholders and responses were received from the following associations:

- **Colipa** (**European Cosmetics Association**, this association represents the cosmetics industry. Its membership consists of 23 national associations both within and outside the EU, 21 major international companies and a number of associated members. In total, Colipa represents over 2000 companies);
- **FEA** (**European Aerosol Federation**), represents the aerosol industry in 18 countries throughout Europe, and represents 530 companies;
- **PZPK** (**Polish Union of Cosmetics Industry**) represents the cosmetics industry in Poland, and is not a member association of Colipa. Its membership includes 56 companies; and
- **AEROBAL** (**International Association of Aluminium Aerosol Container Manufacturers**) represents the aluminium can manufacturing industry and its membership includes 18 companies, all of which are SMEs.

A number of written inputs were received from Colipa/FEA in 2008 and 2009 and a conference call was held with Colipa/FEA and representatives of various companies in April 2009. Written input was received from PZPK and AEROBAL.

Representatives of Colipa, FEA, AEROBAL and several companies also took part in a stakeholder workshop on this issue that took place in Brussels in May 2009. The information gathered from the above association forms the main part of this impact assessment.

14.1.3. Background Information

The product group ‘deodorants and antiperspirants’ comprises several sub-categories with divisions reflecting either variances in the purpose of the product (deodorant vs. antiperspirant) or in the packaging and application format (aerosol spray, roll-on, stick, pump, cream).

Colipa/FEA elaborate on the distinction between deodorants and antiperspirants, with the main differences being summarised below:

- **area of application** – while deodorants are designed so that they can be applied to other parts of the body in addition to the axilla, antiperspirants are intended for application in the underarm only; and
- **functional properties** – antiperspirants have an additional functional purpose which is not offered by deodorants in that they are able to reduce perspiration.

14.1.4. Expected Impacts of the Proposed Option (General Introduction)

Table 118 summarises the relevant market information for the major product categories and details the expected impact of the proposal on the relevant products.

Table 118: Deodorants and antiperspirants and impact of proposed limit

Product format	No. of units sold annually (EU-27)	% of market (no. of units)	Average VOC content (%)	Share of compliant products (% of total sales in each category)	Available as deodorant	Available as antiperspirant
Aerosol spray (deodorants)	549 228 000	25%	97	0	Yes	-
Aerosol spray (antiperspirants)	671 279 000	30%	95	0	-	Yes
Roll-on (alcohol-type)	52 204 000	2%	40-70	0	Rare	Yes
Roll-on (emulsion-type)	467 808 000	21%	3-10	98	No	Yes
Sticks	314 673 000	14%	35-50 (antiperspirants)	0	Rare	Yes
Pumps	152 808 000	7%	<90	n/a	Yes	Yes
Creams/Gels	< 1 % of market	1%	3-10		-	-
Source: Various documents provided by Colipa/FEA						

Table 118 suggests that the adoption of the proposed limit would have a large-scale impact on the current market, as several categories (aerosol-based sprays, alcohol-type roll-ons and stick antiperspirants) presently do not include any products that comply with the proposed limit. In addition, associations and other entities consulted for this study do not believe that development of compliant products in these categories is technically feasible in the medium-term (2-5 years). Thus, the proposed limit, if adopted immediately, is expected lead to the withdrawal from the market of products accounting for 72% of current sales (by number of units or value of sales).

As a consequence, the main product group that would be compliant with the proposed limit would be emulsion-type roll-ons. The impact that the proposal would have on pump sprays is uncertain as stakeholder consultation returned several values on their VOC content. However, the values provided by Colipa/FEA were in the region of either 70% of VOC content as a typical value or up to 90% average VOC content, suggesting that a significant proportion of products within this product group would not meet the proposed limit.

In addition, it was also argued the division between deodorants and antiperspirants (as detailed in Table 1) within the various packaging formats indicates that the proposal would result in the withdrawal from the market of deodorants in all product formats and in the withdrawal of antiperspirants in all product formats, with the exception of roll-on antiperspirants (Colipa, 2009a). This is due to the fact current technology allows effective emulsion roll-ons only as antiperspirants (currently, all emulsion-rolls on the market are only antiperspirants). The only potential exception may be deodorant pumps sprays; however, only very limited information was obtained on the availability of deodorants within this product group.

14.1.5. Impact on the Market with Deodorants and Antiperspirants

Consultation input by Colipa/FEA suggests that the proposed measure may not entail a straightforward shift of consumer allegiances from non-compliant product formats to emulsion-type roll-ons but may lead to more complex changes in the market. Colipa/FEA content that the measure would lead to a significant decrease of the total deodorant/antiperspirant market (both value and volume) by as much as 50%. The reasons given for this include:

- lack of consumer acceptance of compliant alternatives (worse fragrance performance, etc.) and resultant consumer preference for alternative methods of personal care (increased washing and clothes washing, increased reliance on eau de toilete/perfume);
- lower quantity per application of emulsion roll-ons; and
- slow-down in innovation leading to slower market growth in the future.

While it is impossible to reliably quantify the impact of the proposal on the overall value of the market (several factors such as cultural habits or lack of social acceptance of not using personal care products would need to be taken into account), it is clear that if the value of the market were to decrease significantly, this may reduce or accelerate several economic, social and environmental impacts discussed later in this impact assessment. By way of example, the increased use of perfumes and eaux de toilette may negate any environmental benefits derived from reduced VOC emissions from deodorants/antiperspirants as maximum VOC content in perfumes has been indicated as 80% (IVAM, 2005: 18).[71] Data provided by Colipa/FEA indicate that typical VOC concentrations in eaux de toilette may be 75-80 % and the VOC content of perfumes may reach 100%.

14.2. VOC and ozone reduction potential

14.2.1. Availability of data

The identification of the potential VOC reductions, resulting from a ban of aerosol-based deodorants and antiperspirants, is based on detailed provided by FEA and Colipa. The data covers current market statistics as well as existing average VOC contents for all relevant product types of deodorants and antiperspirants.

As data provided by stakeholders covers the market situation at EU-27 as a whole only, it had been agreed between parties to distribute these figures across countries using national population data provided by EuroStat. Furthermore, industry experts from FEA and Colipa suggested the application of different per capita consumption rates to distinguish between old and new Member States. Therefore, a per capita consumption for new member states of only half as high compared to old member states has been implemented in the estimations.

The estimation of data on a country-specific level for the EU-27 Member States plus Croatia and Turkey was accomplished using national population data provided by EuroStat database. Data for the EU-27 as provided by FEA and Colipa for each product group were distributed among Member States applying their respective share of national population in total EU-27 population.

For the inclusion of Croatia and Turkey, the ratio between total population of the EU-27 and the EU-27+2 has been estimated. This factor was used to extrapolate the EU-27 totals for each product group to the EU-27+2 aggregate level. To estimate the national share of these totals for Croatia and Turkey, their respective share in the difference between total population of the EU-27 and the EU-27+2 has been applied.

The resulting distributed amounts of sales of each product group were used to estimate the VOC emissions per country and product type. For these estima-

71 IVAM (2005): VOC emissions from cosmetics and cleaning agents, Amsterdam 2005

tions the average VOC contents per product group as shown in the table above were applied. In cases where VOC contents are given as a range of percentages, average VOC contents were estimated and applied for the estimations of total VOC emissions.

Data for creams has been estimated applying the reported total of 173.4 kt and the statement of Creams/Gels only accounting for “<1% market share”. For the estimations the market share has been assumed to be 1%.

14.2.2. Approach of projection for scenarios in 2010, 2015 and 2020

For the extrapolation of current data to 2010, 2015 and 2020, a stable market development has been assumed. Therefore, the development of the market for deodorants and antiperspirants has been assumed to grow at the same pace as national population is assumed to develop according to projections by EuroStat.

These projections are available for all of the EU-27+2 Member States. In order to estimate the development of national populations in Croatia and Turkey, the average population growth for the EU-27 for each of the regarded years has been used.

14.2.3. Description of scenarios and estimation of reduction potentials

The reduction potential for each country of the EU-27+2 was estimated comparing the VOC emissions from a “business-as-usual” (BAU) scenario without regulatory changes and two DECOPAINT-NEW scenarios where the above described ban of aerosol-based deodorants and antiperspirants has been implemented into legislation. The two DECOPAINT-NEW scenarios differ with respect to the assumption of the degree of substitution of these banned products with the remaining roll-ons and creams. The scenarios are described in more detail in this chapter.

14.2.3.1. Business as usual scenario (BAU)

In the BAU scenario a case without new regulatory measures being introduced to the market is examined. To estimate the BAU scenarios for 2010, 2015 and 2020, data on national population growth has been applied. Therefore, changes with respect to the original data provided by FEA and Colipa result from differences in the amount of sales for the respective years. Only those countries with negative population growth will report a decrease in VOC emissions for the BAU scenarios.

14.2.3.2. DECOPAINT-NEW scenarios for option 12a

For the DECOPAINT-NEW scenario data on sales has been extrapolated analogously to the BAU scenario. An estimation of a reduction scenario for

2010 has not been carried out as the time period for manufacturers for implementing the new limits was assumed to be too short.

In contrast to the BAU scenario, the DECOPAINT-NEW scenario is used to examine the changes resulting from new regulatory interventions such as the implementation of a VOC limit value of 10%, resulting in the removal of all aerosol-based product types of deodorants and antiperspirants from the market.

In accordance with experts from FEA and Colipa, two scenarios with respect to the behaviour of consumers have been analysed. The first scenario, henceforth scenario a), assumes that only 20% of the current sales of aerosol-based deodorants and antiperspirants will be replaced by consumption of roll-ons and creams. This scenario leads to a strong decline in the overall deodorant and antiperspirant market. The second scenario (scenario b)) regards a substitution of 80% of the banned products by roll-ons and creams, softening the effect of the decrease in consumption. It is assumed that 80% (20%) of the current consumers of deodorants and antiperspirants will not use these products anymore. These consumers might switch to parfumes or similar products with high VOC contents. However, this shift in consumption is not part of the present analysis. The consumers who are not shifting to other deodorants or antiperspirants are assumed to leave the market of deodorants and antiperspirants. These two scenarios are supposed to analyse the reduction potential of very different behaviours of consumers which might be the outcome of individual preferences and product loyality.

The substituted amount of sales was distributed among the two remaining product types with respect to their current market shares. As a result, almost 94% of the substituted amounts were covered by roll-ons (emulsion-type) while only about 6% were covered by creams. This is an outcome of the above mentioned low market share of creams.

The table below presents the reduction potentials resulting from an implementation of the 10% VOC limit for deodorants and antiperspirants and the resulting disappearance of the products from the market. The results are shown per country of the EU-27, the EU-27 total and nation reduction potentials for the accession countries Croatia and Turkey.

The figures result from a comparison of the unregulated BAU scenario and the DECOPAINT-NEW scenarios a) and b) including the proposed regulation.[72] The table presents a reduction potential for the EU-27 between 126 kt and 133 kt for 2015 and 2020 respectively.

[72] For the estimations of the reduction potential an emission factor of 0.95 was applied. Thus, not all of the VOC content is emitted but 5% of the VOC are assumed to remain in the container and are not released into the air. This factor is based on an agreement of experts during the compilation of the German emission inventory.

Table 119: Reduction potentials for Option 12 a per country, in kt

Country	2015		2020	
	Scenario a) kt	Scenario b) kt	Scenario a) kt	Scenario b) kt
Austria	2.47	2.37	2.51	2.41
Belgium	3.19	3.06	3.26	3.13
Bulgaria	1.06	1.02	1.04	0.99
Cyprus	0.13	0.12	0.14	0.13
Czech Republic	1.51	1.45	1.52	1.46
Denmark	1.61	1.55	1.63	1.57
Estonia	0.19	0.18	0.19	0.18
Finland	1.56	1.50	1.58	1.52
France	18.49	17.76	18.90	18.15
Germany	23.58	22.64	23.46	22.54
Greece	3.31	3.17	3.33	3.20
Hungary	1.43	1.38	1.42	1.37
Ireland	1.46	1.40	1.56	1.49
Italy	17.55	16.85	17.69	16.99
Latvia	0.32	0.30	0.31	0.30
Lithuania	0.47	0.45	0.46	0.45
Luxemburg	0.15	0.14	0.16	0.15
Malta	0.06	0.06	0.06	0.06
Netherlands	4.81	4.62	4.87	4.67
Poland	5.48	5.26	5.47	5.25
Portugal	3.15	3.03	3.20	3.07
Romania	3.04	2.92	3.00	2.88
Slovakia	0.78	0.75	0.78	0.75
Slovenia	0.30	0.28	0.30	0.28
Spain	14.22	13.66	14.72	14.14
Sweden	2.76	2.65	2.84	2.73
UK	18.37	17.64	18.92	18.17
EU-27	131.46	126.25	133.31	128.02
Croatia	0.66	0.63	0.67	0.64
Turkey	10.33	9.92	10.45	10.04

14.3. Economic Impacts

14.3.1. Impact on public authorities

Member State authorities were requested to assess the expected impact of the proposals relating to cosmetic products on monitoring and surveillance costs. The results are summarised in Table 120 (please note that Member State responses in Table 120 relate to proposal on deodorants/antiperspirants as well as to the proposal on hairsprays).

Table 120: Anticipated increase/decrease of surveillance and monitoring costs incurred by Member State authorities due to Options 12a, 12b, and 12c

Member State	Change in monitoring and surveillance cost
Bulgaria	+
Czech Republic	+
Cyprus	++
Estonia	+
Hungary	+
Greece	0
Ireland	++
Romania	++
Slovenia	++
Spain	+
Key: Member States were asked to rate the expected increase/decrease of surveillance and monitoring costs on a scale --, -, 0, +, ++, i.e. ranging between a strong reduction of the average costs to a strong increase.	

It is of note that four out of ten responding Member States expect a strong increase in monitoring costs and a further five expect an increase. The Irish authorities point out that cosmetic products share little in common with products currently within the scope of Directive 2004/42/EC and, as such, the authorities would incur costs due to the need to conduct initial research on the sector and on the relevant distribution channels.

Colipa/FEA estimate that the measure would lead to a reduction of tax revenue collected throughout the EU by approximately € 200-250 million. However, no other information underpinning this figure was provided; as such, it was impossible to determine what assumptions (such as market scenarios) this figure is based on.

14.3.2. Capital investment and stranded assets

Deodorant/antiperspirant manufacturers

There are some significant data gaps in relation to baseline indicators on the deodorant/antiperspirant production sector. There are approximately 2000 firms active within the European cosmetics sector, most of which are SMEs, but the number of firms engaged in the production of deodorants and antiperspirants is not known and as such the number of companies that are likely to be affected by the proposal cannot be determined.

Consultation conducted with associations of deodorant and antiperspirant manufacturers (Colipa/FEA and PZPK) indicates that, in order to comply with the proposal, manufacturers would need to invest in:

- increased production capacity for compliant alternatives;

- reformulation of existing emulsion-type rolls-ons in order to increase their attractiveness for former users of other products; and
- R&D efforts to develop new systems for non-compliant product formats.[73]

In a scenario where the current market for aerosol deodorants and antiperspirants is to be substituted by emulsion-type roll-ons, Colipa/FEA estimate that capital investment to be made into increasing the EU production capacity of emulsion-type roll-ons would be in the region of € 120-150 million. However, it is argued that such a shift would involve other types of investment relating to the development of new products and setting-up of relevant manufacturing facilities (including those for packaging). Colipa/FEA estimates that cost of new product development (reformulation) would be in the region of € tens of millions. This includes efficacy assessment, reformulation, safety assessment update, and stability testing for all product formats. Reformulation would be necessary for sticks and pump sprays while new systems would have to be developed in the aerosol spray and stick segments. PZPK lists activities that would have to be undertaken due to the proposed limit and that would necessitate investment (purchase of new equipment including packaging lines, testing, safety assessment, etc.) but quantitative estimates were not provided.

Colipa/FEA further note that SMEs often compete on the basis of lower cost private label products and as such SMEs may find it more difficult to assume the cost of significant R&D that would be triggered if the proposal were to be adopted.

Consultees were confronted with two hypothetical scenarios that enquired about costs incurred due to stranded assets if the proposal were to enter in force in 2011 or delayed until 2014. Colipa/FEA note that 2011 is not a feasible timeline and no estimate of the value of stranded assests was provided. If date of entry into force were to be in 2014, stranded assets were valued at several hundred million euros (an estimate of € 250-300 million for manufacturers of deodorants/antiperspirants was provided).

The study team estimates that the cost of capital investment and stranded assets may represent between 10% - 40% of 2014 annual sales by deodorant and antiperspirant manufacturers, assuming that the value of the EU market does not decline following the introduction of the measure. The above calculations are based on a number of assumptions that reflect worst-case scenarios for deodorant and antiperspirant manufacturers.[74] A key uncertainty in the ranges relates to a lack of information on the retail prices currently paid for end-products.

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[73] However, stakeholders stressed that such systems could probably not be developed within the upcoming 2-5 years

[74] These calculations are based entirely on data provided by Colipa/FEA and on the following scenarios: Average price per unit between €1-4 which was given for aerosols and roll-ons is assumed to apply for all product formats. Production data taken for EU-27 in 2007 was adjusted on the basis of a 1% annual growth rate until 2014 (Colipa/FEA estimate 0-2%), retailer mark-up assumed to be 30%, and exports are assumed to cease altogether following introduction of the measure (95-100% of companies would discontinue exports of non-compliant products). Capital investment costs assumed to total €249 million and stranded assets assumed to be €300 million.

However, a certain proportion of the above costs would be incurred by cosmetics companies even in a scenario with no legislative intervention. A survey conducted for RPA (2007)[75] found that cosmetics companies replace or reformulate approximately 24 % of their product formulations each year, suggesting that companies may completely reformulate or replace their product range approximately every four years, with the speed of product range replacement being faster for medium and large companies than for small enterprises (see Table 121).

Table 121: Annual formulation replacement and reformulation rates in RPA (2007) survey (% of product formulations replaced or reformulated each year)

Company size	Lowest response (%)	Highest response (%)	Average (%)
Small	10	25	19
Medium	5	60	26
Large	10	50	25
All	5	60	24

14.3.3. Impact on competitiveness and trade in relation to commerce with non-EU countries

Currently, the vast majority of antiperspirants and deodorants sold in the EU are manufactured within the Community, with imports accounting for less than 10% of current sales. Colipa/FEA respond that the proposed limit may lead to increased sourcing from low cost locations (which may be within or outside the EU) due to the fact that manufacture of roll-ons technically less demanding.

Less than 15% of EU production (by value) presently is exported. Colipa/FEA expects that following the introduction of the proposed limit, the complexity of managing dual production of compliant and non-compliant products would lead to more than 95% of companies to cease manufacture of non-compliant products for export to non-EU markets and as such production would be relocated to locations outside the EU.

PZPK echoed some of the comments made by Colipa/FEA in suggesting that the measure would lead to increased reliance on imports and relocation to production to non-EU countries. In addition, it was suggested that the measure may lead to the emergence of the grey market.

[75] RPA (2007): Impact of European Regulation on the EU Cosmetics Industry, Available from the European Commission Internet Site, http://ec.europa.eu/enterprise/cosmetics/doc/study_impact_eur_regul_cosmetics.pdf, Accessed on 15th May 2009

14.3.4. Impact on functioning of the internal market and competition

Other costs indicated by consultees include increased market concentration, a negative impact on exports and a potential relocation of production to facilities outside the EU; these impacts are elaborated on in subsequent paragraphs.

Consultees expect the proposed measure to lead to increased market concentration and the presence of fewer brands on the market, thus significantly increasing start-up costs for new market entrants (this is due to higher costs of brand building and advertising). While it is noted that a beneficial impact on profit margins derived by large manufacturers from products compliant with the proposed limit (such as emulsion roll-ons) is to be expected, mainly due to increased economics of scale and increased production in low-cost locations, it is argued that the cost of investment into increasing production of compliant products and from stranded assets will result in a decline in overall profitability of most companies (Colipa/FEA).

It was not possible to estimate the number of deodorant/antiperspirant manufacturers that are likely to leave the market or cease operation altogether. However, it was noted by AEROBAL that the measure would lead to the closing down of “many businesses” that are members of this association.

14.3.5. Impact on innovation and research

Colipa/FEA argue that innovation is likely to focus on the roll-on segment as development of compliant aerosol sprays would be a costly exercise with a highly uncertain outcome. Innovation would thus aim to improve the performance of roll-ons in order to increase their attractiveness to former aerosol consumers. Colipa/FEA note that innovation triggered by this measure would lead to companies incurring costs in the region of € tens of millions, including costs due to the product validation process (consumer validation costs €40,000 per test).

14.3.6. Impact on conduct of businesses, impacts across supply chain and SMEs

14.3.6.1. Impacts across supply chain

According to Colipa/FEA, manufacturers of VOCs for use in deodorant and antiperspirant aerosols are not likely to be severely impacted as freed production capacity may be used to supply other sectors. Similarly, fragrance manufacturers are not expected to be significantly affected. However, consultees expect that the measure would create more significant problems for packaging suppliers (cans, valves, actuators), manufacturers of can making and aerosol filling equipment and materials, and in several other sectors throughout the supply chain.[76]

In particular, consultees highlighted the impact that the proposed measure is expected to have on can suppliers. AEROBAL (the International Association of Aluminium Aerosol Container Manufaturers) represents 18 European producers of aluminium cans with a total employment of 3,500 and an annual turnover of €510 million. AEROBAL's members are characterised by high reliance on cosmetics manufacturers, with 50% of its output currently supplying deodorant/antiperspirant production (AEROBAL). AEROBAL expects proposed measures relating to hairsprays and deodorants/antiperspirants to lead to 'many' businesses going out of operation.

AEROBAL collected information from a number of aluminium can manufacturers and from selected machine and slug producers and provided the consultants with estimates of job losses that these companies expect to incur as a result of Option 12a (deodorants/antiperspirants) and Option 12b (hairsprays). AEROBAL expects a loss of 3000 jobs in 18 companies surveyed in the aluminium can manufacturing sector, 500 jobs in the three surveyed machine suppliers and 500 jobs in the nine companies surveyed in the slug supplying sector. This indicates a potential total job loss of 4000, not including other segments of the supply chain, where, according to AEROBAL, substantial job losses are to be expected as well.

In support of the above data, AEROBAL underlined the high capital intensive nature of this sector and no potential for the relevant can manufacturing equipment to be used for other types of production. In addition, it was noted that the surveyed machine and slug producers are in turn dependent to a critical degree on the aerosol aluminium can manufacturing sector.

However, AEROBAL does not seem to represent the entire aerosol can sector. By means of example, several members of the Metal Packaging Manufacturers Association are engaged in the production of metal aerosol cans.

Colipa/FEA note that the proposed measure would have an impact across the entire supply chain, thus affecting suppliers of raw materials, packaging, distributors, etc. It was noted that substantial losses would be incurred within the supply chain with stranded assets by can and valve suppliers estimated at € 300-400 million.

14.3.6.2. Impacts on SMEs

It has been noted that the measure would have a disproportionate impact on SMEs that are deodorant/antiperspirant manufacturers due to the fact that they may find it more difficult to bear the cost of R&D associated with the changes triggered by the measure. PZPK notes that for SMEs that are specialised in aerosol production, deodorants and antiperspirants usually account for majority of production and such these companies may be forced out of business.

[76] The sectors that were indicated include metal coating, aluminium slug making, valve producers, machine producers.

14.3.7. Impacts on consumers

14.3.7.1. Price of product

The main impacts that the proposed measure may have on consumers relate to potential changes in the retail price paid for end-products, anticipated reduction in consumer choice and comparatively worse functional performance of compliant alternatives.

It has not been possible to quantify the expected impact on retail prices of deodorants and antiperspirants; however, consultation responses by Colipa/FEA and AEROBAL indicate several types of expected impacts:

- upward pressure on price due to diminished market competition and the need to recover investments in stranded assets; and
- downward pressure on price due to lower rates of innovation,[77] higher profit margins on emulsion-type roll-ons and relocation of production to low-cost countries.

The above factors may include those that would play a role in the short term and in the long term and more precise estimates of the magnitude of each and of time frame over which they would be applicable could not be determined.

Roll-ons provide the consumer with a longer lasting solution (a roll-on unit lasts for 50-70 days before becoming empty) while aerosol sprays only last between 30-40 days.

14.3.7.2. Product quality and consumer choice

In relation to the expected impacts on consumers, it is clear that consumer choice would be narrowed down to fewer application formats. Based on the products that are currently on the market, the following product formats would not meet the proposed limit: aerosol sprays (deodorants/antiperspirants), alcohol-type roll-ons, and sticks (Colipa/FEA, PZPK) thus significantly narrowing down consumer choice.

Colipa/FEA state that due to the fact that proposed limit would result in withdrawal from the market of several product formats, consumers would be faced with a loss of utility due to different performance characteristics of the compliant alternatives.

Colipa/FEA detail the purposes of VOCs in aerosol products and their functional advantages as follows:

- act as solvent, carrier and co-solvent;
- ensure quick drying due to fast evaporation following use;

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[77] Consultants assume that innovation here refers to long-term innovation, which may be narrowed down to innovation within the emulsion-type roll-on segment.

- break-up of application stream into specific droplet sizes thus ensuring pleasant application; and
- ensure constant pressure in container throughout product's life-time.

As a result of withdrawal of VOCs, the following arguments about resulting functional disadvantages have been put forward by the consultees:

- emulsion-type roll-on, unlike aerosol products, is based on contact application and thus cannot be shared among several users;
- roll-ons, creams, water-based pump sprays are seen as slower-drying, wetter and stickier than aerosols;
- deodorant aerosols are used as bodysprays while antiperspirant roll-ons can only be applied to the underarm;
- aerosol sprays allow for uniform and continuous application which cannot be provided by pump sprays; and
- performance of fragrances in deodorants/antiperspirants is negatively impacted by water-based formulations and contact application.

In summary, it is argued by Colipa/FEA that the proposal would lead to a significant loss of functional advantages preferred by consumers. This assumption is supported by the fact that products that would not comply with the proposed limit are currently preferred by consumers and account for over 70% of the market.

In addition, PZPK notes that a large number of consumers prefer aerosol over roll-ons due to non-contact application and roll-ons (in particular alcohol-free roll-ons) are wetter and have a longer drying time and higher propensity to soil textiles.

14.3.8. Impact on employment

Colipa/FEA notes that the European cosmetics sector has a direct or indirect employment of 500,000. In relation to the impact of the proposal, the worst-case scenario estimated by Colipa/FEA anticipates a total loss of 4000 - 5000 jobs across the EU (Colipa/FEA). The data on which the above estimate is based are not known and as such these estimates are impossible to verify or relate to expected market scenarios used elsewhere in this study. In addition, it is unclear whether the above estimate includes job losses incurred by suppliers of cans. AEROBAL foresees "massive" job losses in the aerosol can production sector. PZPK expects a loss of 30 - 60 per each aerosol producing SME but the number of such SMEs in Poland or in any other Member State is not given.

14.3.9. Impacts on specific countries/regions

It is noted that aerosol filling is concentrated in several Member States (UK, Germany, the Netherlands, and France) and as a consequence these countries are likely to be affected by the proposal more than the other EU countries (Colipa/FEA). This has been partially confirmed by AFC/BiPRO/DFIU [EC, 2002] which provides production data for various aerosol products in EU15 in 2000. These data indicate that the UK, Germany, and France were the largest producers of cosmetics aerosols. However, the report also suggests that aerosol production in the Netherlands mainly relates to non-cosmetic aerosols.

14.4. Social Impacts

14.4.1. Health impacts

The implementation of the different scenarios for option 12a and 12b will result in a reduction of anthropogenic VOC emission which may result in a marginal reduction of average ground level ozone concentration in EU-27, Croatia and Turkey. As described before for option 12a, two different VOC-reduction scenarios have been considered for 2015 and 2020 with respect to different behaviour of consumers. In the following table the modelled effects on human health due to this change in the air quality are shown. For the calculations average meteorological conditions and the 2020 reference emission scenario have been used. The figures in the table take into account that the VOC reductions within EU-27+2 will also change the exposure of population in neighbouring countries (total Europe, EMEP grid). By considering only the impacts within EU-27 and Croatia/Turkey, the externalities will decrease.

Table 122: Health benefits in 2015 and 2020 for option 12a due to reduction of VOC emissions related to ground level ozone reduction

		2015		2020	
		Scenario a)	Scenario b)	Scenario a)	Scenario b)
Reduced external costs	[€_00][78]	28,401,879	27,276,772	28,761,825	27,622,458
Mortality	YOLL	203.147	195.100	205.722	197.573
Morbitity RHA, ages over 65	cases	114.99	110.44	116.45	111.84
MDR, ages 18-64	days	458,987	440,804	464,803	446,391
RMU by adults	cases	166,733	160,128	168,846	162,157
RHA = cases of restricted hospital admissions; MDR = restricted activity days RMU = cases of respiratory medication use, YOLL = Years of Life Lost.					

[78] The monetary values reported in this table are expressed in Euro on the basis of the value of the Euro in the year 2000. The estimation of the monetary values expressed in Euros of 2000 enables a comparison of the monetary values estimated for 2015 and 2020.

14.5. Environmental Impacts

14.5.1. Changes in the Ground Level Ozone Concentration

The reduction of VOC emissions may reduce the ground level ozone concentration in Europe. The correlation between the VOC emission reduction and ozone concentration is a non-linear and it is influenced by a number of parameters, e.g. the NO2 background concentrations and the meteorological conditions have a relevant impact on the processes. The region or country where the VOC emissions are reduced have as well a relevant impact on the European wide changes in the ozone concentration.

The impacts of options 12a on the ground level ozone concentrations are shown in the following table. For the calculations average meteorological conditions and the reference emission scenario for 2020 have been assumed. The impacts of the option have been assessed for the years 2015 and 2020.

Table 123: Impact of option 12a on the average ground level ozone concentration within EU-27 + Croatia and Turkey.

	average O3 concentration [ppb]	
	changes in [ppb]	percental changes
Scenario a)		
2015	0.015	0.052%
2020	0.015	0.053%
Scenario b)		
2015	0.015	0.050%
2020	0.015	0.051%

The ozone reduction may also contribute to prevent part of the production losses due to crop damage. The benefit of the VOC reduction due to the new regulation as proposed by options 12a has been quantified for scenario a) of option 12a in 2015 to be €14,648,181 and for 2020 to be €14,853,773. For scenario b) of option 12a the estimated benefits were €14,067,910 for 2015 and €14,265,358 for 2020.

14.6. Summary of Impacts

Table 124 below summarises the main impacts of Option 12a.

Table 124: Option 12a - Summary of Impacts

Impact/Stakeholder	Manufacturers	Suppliers	Consumers	Member State Authorities
Economic				
Capital/investment costs	--	--		
Operating costs	+			
Product and raw material prices	?	-	?	
Imports/competitiveness	-/?			
Competition	-/?			
Innovation/research	?			
Product performance			--	
Monitoring/Surveillance costs/Tax Revenue				-/? (tax revenue) -- (monitoring cost)
Social				
Employment	--	--		
Consumer choice			--	
Environmental				
Cross media	-/?			
Waste and recycling	-			
Fuel consumption vehicle emissions	+/-			
Use of renewable/non-renewable resources	+/-			

Key:
0 = no impact
+/- = uncertain impact positive or negative
-/? = likely slightly negative impact but unquantifiable due to lack of data
+ = Positive impact
++ = Strongly positive impact
- = Negative impact
-- = Strongly negative impact
Note: Member State monitoring costs refer to Options 12a, 12b and 12c being adopted simultaneously.

14.7. Description of Option and Background Information (Option 12b: Introduction of a VOC limit for hairsprays)

14.7.1. Option 12b: Introduction of a limit on VOC content in hairsprays

This option assumes that a limit on VOC content in hairsprays is introduced, with the limit value being set at 90% w/w.

Following a proposal of Colipa and FEA [Colipa/FEA, 2009a], hairsprays are defined as follows:

- Hairspray: product which is used to provide sufficient rigidity, to hold, retain and/or finish the style of the hair for a period of time.

14.7.2. Summary of Consultation

We conducted consultation on the above proposal with interested stakeholders and we received responses from the following associations:

- **Colipa** (European Cosmetics Association);
- **FEA** (European Aerosol Federation);
- **PZPK** (Polish Union of Cosmetics Industry); and
- **AEROBAL** (International Association of Aluminium Aerosol Container Manufacturers).

14.7.3. Background Information and Expected Impacts

Presently, the hairspray market includes two product formats: aerosol hairsprays and pump hairsprays. The proposed limit would apply to both product types. Table 125 below provides background data relating to the two hairspray formats and the anticipated impact of the proposal.

Table 125: Background data on hairsprays and impact of proposed limit

Hairspray type	Production (units produced in EU-27 in 2007)	Average VOC content (%)	Relative market shares (aerosol vs. pump)	Sales of products with VOC content of 90% or lower (% of total sales in relevant Category)
Aerosol	556,570,000	95%	94-95%	5-10%
Pump	28,000,000	80-95%[1]	5-6%	-
Notes: 1) Typical values 90-95% Source: [Colipa/FEA, 2009a], [Colipa/FEA, 2009c]				

Table 125, which is based on Colipa/FEA data, indicates that approximately 90-95% of aerosol hairsprays that are currently on the market exceed the proposed limit, while the proportion of non-compliant pump hairsprays is unknown. By contrast, consultation input provided by PZPK suggests that various hair aerosols may contain a range of VOC contents but that these do not usually exceed 90%. The reason for this discrepancy is not known.

The limit proposed for hairsprays is not expected to lead to replacement of aerosols with alternative product formats and rather necessitates reformulation of existing products, with both product formats being affected. While Table 5 indicates that the average content in some pump hairsprays may be as low as 80%, if the typical VOC content values are between 90-95% (as indicated by Colipa/FEA), then a proportion of pump hairsprays may need to be reformulated to meet the proposed limit. Reformulation entails replacement of the liquefied propellant (VOC) with alcohol, thus, leading to a very small or even a zero net VOC reduction. As a result, the market share of pump sprays is not expected to increase following adoption of proposed measure.[79]

14.8. VOC and ozone reduction potential

14.8.1. Availability of data

As for option 12 a, data for option 12b was provided by FEA and Colipa including information on current market shares, output and existing average VOC contents. Data for hairsprays was provided in sales of units on aggregated EU-27 level. In combination with reported average contents in ml and the average density, the total amount of hairsprays sold were estimated to be about 109 kt aerosol-based sprays and 3 kt pumps

The estimation of data on a country-specific level for the EU-27 Member States plus Croatia and Turkey was accomplished analogously to the approach in op-

79 Pump sprays have some important functional disadvantages in comparison with aerosols as they cannot deliver as controllable and constant spray patterns and instead deliver larger particles and necessitate a longer drying time.

tion 12a, using national population data provided by EuroStat database. Industry experts from FEA and Colipa suggested the application of different per capita consumption rates to distinguish between old and new Member States. Therefore, a per capita consumption for new member states of only half as high compared to old member states has been implemented in the estimations.

For the inclusion of Croatia and Turkey, the ratio between total population of the EU-27 and the EU-27+2 has been estimated. This factor was used to extrapolate the EU-27 totals for each product group to the EU-27+2 aggregate level. To estimate the national share of these totals for Croatia and Turkey, their respective share in the difference between total population of the EU-27 and the EU-27+2 has been applied.

The resulting distributed amounts of sales of each product group were used to estimate the VOC emissions per country and product type. For these estimations the average VOC contents per product group as shown in the table above were applied. The share of products with VOC contents below 90% for aerosol-based sprays has also been provided by FEA and Colipa. For pumps, experts suggested using a share of 50% to 70% of sales containing more than 90%.

Therefore, the new VOC limit value of 90% will affect 90% of the aerosol-based sprays – while 10% already contain 90% of VOC – and 40% of pumps – with 60% already containing 90% of VOC.

14.8.2. Approach of projection for scenarios in 2010, 2015 and 2020

As for the extrapolations of data for option 12a, a stable market development has been assumed for the estimation of data for 2010, 2015 and 2020. Therefore, the development of the market for deodorants and antiperspirants has been assumed to grow at the same pace as national population is assumed to develop according to projections by EuroStat.

These projections are available for all of the EU-27+2 Member States. In order to estimate the development of national populations in Croatia and Turkey, the average population growth for the EU-27 for each of the regarded years has been used.

14.8.3. Description of scenarios and estimation of reduction potentials

The reduction potential for each country of the EU-27+2 was estimated comparing the VOC emissions from the DECOPAINT-NEW scenarios where the above described new VOC limit was set to 90% and a “business-as-usual” (BAU) scenario without regulatory changes. Both scenarios are described in more detail in this chapter.

14.8.3.1. Business as usual scenario (BAU)

The BAU scenario was estimated applying the above mentioned growth rates of population to estimate the future development of sales in the hairspray segment of cosmetics products. The future scenarios included the years 2010, 2015 and 2020 as these will also be the years the impact assessment will focus on. In the BAU scenario no regulatory interventions have been regarded.

14.8.3.2. DECOPAINT-NEW scenario for option 12b

For the DECOPAINT-NEW scenario the development of the market is analogous to the BAU scenario.

The scenario examines the introduction of a regulation limiting the VOC content of hairspray products to 90%. This regulatory intervention was assumed to lead to a shift from products with higher VOC contents to those achieving this limit. Furthermore, it has been assumed that this shift to lower VOC products will not include a decline in consumption of hairspray products.

The table below shows the resulting reduction potentials for each of the EU-27 Member States, Croatia and Turkey.[80] A potential VOC reduction of about 5 kt has been estimated for the EU-27.

[80] For the estimations of the reduction potential an emission factor of 0.95 was applied. Thus, not all of the VOC content is emitted but 5% of the VOC are assumed to remain in the container and are not released into the air. This factor is based on an agreement of experts during the compilation of the German emission inventory.

Table 126: VOC reduction potentials from inclusion of hairsprays (Option 12b)

Country	2015	2020
	kt	kt
Austria	0.09	0.09
Belgium	0.12	0.12
Bulgaria	0.04	0.04
Cyprus	0.00	0.01
Czech Republic	0.06	0.06
Denmark	0.06	0.06
Estonia	0.01	0.01
Finland	0.06	0.06
France	0.69	0.71
Germany	0.88	0.88
Greece	0.12	0.12
Hungary	0.05	0.05
Ireland	0.05	0.06
Italy	0.66	0.66
Latvia	0.01	0.01
Lithuania	0.02	0.02
Luxemburg	0.01	0.01
Malta	0.00	0.00
Netherlands	0.18	0.18
Poland	0.21	0.20
Portugal	0.12	0.12
Romania	0.11	0.11
Slovakia	0.03	0.03
Slovenia	0.01	0.01
Spain	0.53	0.55
Sweden	0.10	0.11
UK	0.69	0.71
EU-27	4.92	4.99
Croatia	0.02	0.02
Turkey	0.39	0.39

14.9. Economic Impacts

14.9.1. Impact on public authorities

Member State authorities were requested to assess the expected impact of the proposals relating to cosmetic products on monitoring and surveillance costs. The results are summarised in previous chapter of this report.

14.9.2. Capital investment and stranded assets

Hairspray manufacturers

The number of companies engaged in EU-based hairspray production is not known and consequently the number of companies that may be affected by the proposal could not be determined; however, it is estimated that 90% of companies producing aerosol hairsprays are currently producing non-compliant products.

In their consultation response, Colipa and FEA estimate that the cost of investment incurred by manufacturers due to product reformulation[81] and due to the anticipated need to use DME[82] may be as high as €1 million per each product brand, with the exact value depending on the number of formulations sold under each brand. However, while the estimate was provided on a per brand basis, data on hairspray aerosol brands that are currently on the market (and on the number of formulations within each brand) are not collected by Colipa/FEA and as such could not be provided to the consultants.

The timeframe needed by companies to reformulate a product is estimated at three years.[83] In addition, it is noted that hairsprays have a three year shelf life suggesting that the necessary adjustment time may need to be longer than the three years required for reformulation.

However, it is of note that cosmetics companies reformulate their products on an ongoing basis (see chapters on deodorants for more information) and as a result some reformulation costs would also be incurred in a scenario with no legislative intervention. In addition, it seems that the industry may have some degree of experience with the use of DME as an aerosol propellant. AFC/BiPRO/DFIU [EC, 2002] noted that in addition to propane/butane, DME was a common propellant used in aerosols and has solvent properties that are 'desirable' in some aerosol product formulations (e.g. hairsprays).

14.9.3. Impact on competitiveness and trade in relation to commerce with non-EU countries

At present, the import of hairsprays into the EU is reported to be insignificant, while relatively large quantities of hairsprays are exported (estimated by Colipa/FEA at 5-30% of the value of EU-based production). It is suggested that companies would not find it possible to manage dual production of compliant

[81] Compliant products are already available but they may not meet requirements of former users of high-VOC products. According to Colipa/FEA, product reformulation would entail: development of new product formulation and efficacy and safety assessments, development of suitable containers and valves, etc., process development and scale up, standard development, stability and consumer acceptance tests, testing of new formulation and its can compatibility, artwork change.

[82] DME would be used as propellant as current propellants are not compatible with water. DME has different properties from liquefied propane/butane (used currently as propellant) and as consequence, gaskets and aerosol filling equipment would have to be redesigned. In addition, cans may need protective layer to prevent corrosion.

[83] This relates to the minimum time needed to launch a new product detailed by Colipa/FEA.

products for the EU market and non-compliant products for external markets. At the same time, due to poorer performance properties, products with less than 90% VOC content may not be accepted in external markets. These factors lead Colipa/FEA to report a potential for relocation of some production to facilities outside the EU.

14.9.4. Impact on functioning of the internal market and competition

Colipa/FEA envisage a small increase in start-up costs for new market entrants (between 1 - 2.5%) but further explanation of why this is expected is required. Profit margins of compliant alternatives are expected to be lower due to higher packaging and raw material costs[84] and due to an expected lower demand from the professional sector.

14.9.5. Impact on conduct of businesses, impacts across supply chain and SMEs

14.9.5.1. Impacts across supply chain

It is expected that companies across the supply chain would be impacted by the proposal. Product reformulation is expected to lead to changes in the raw material supply chain, in particular due to propane-butane in hairspray formulations being replaced by DME, thus impacting on suppliers of these chemicals (Colipa/FEA).[85]

While the proposed option is expected to affect manufacturers of aerosol cans, the impacts are expected to be somewhat different from those previously reported for Option 12a (deodorants/antiperspirants). This is due to the fact that hairsprays account for a smaller proportion of aluminium can manufacturers' output than deodorants/antiperspirants (AEROBAL notes that all hair care products including hairsprays, hair mousses, etc. account for 20% of the sector's unit sales) and due to the fact that while a decline in hairspray sales is expected, this does not amount to a withdrawal of all aerosols from the market as was the case with Option 12a. However, it is anticipated that aerosol can manufacturers may be required to adjust their production processes to include an internal protective lacquer in the can in order to prevent corrosion that may be caused by water addition in products compliant with the proposed limit.

14.9.5.2. Impacts on consumers and professional users

The main impacts on consumers and professional users are expected to stem from a potential loss of performance advantages specific to products with VOC

[84] As noted later in this Section, DME is reported to be 50% more expensive than propane/butane.

[85] The use of DME may also reduce the use of ethanol. Switch from liquefied gas to compressed gas may also increase the need for other solvents. Liquefied gases act as co-solvents. There may also be changes in the use of particular resins and perfumes as these may presently be tailored for propane/butane-based mixtures.

content exceeding 90% and from a potential increase in the retail price of hair-sprays.

Colipa/FEA argue that lowering VOC content below 90% may result in the loss of some of the functional advantages offered by higher-VOC products. It is argued that compliant products may be characterised by a wet feel on application and by diminished capacity to 'hold the style.' Impacts due to potential loss of functional properties are expected to affect the consumer as well as the professional market, with negative implications for professional applications stressed by Colipa/FEA.

In relation to consumer use, it is of note that Colipa/FEA quote a study that found that 12 – 18% of men and 34 – 50% of women in Europe use hairsprays at least once weekly. Therefore, any potential loss of functional properties of hairsprays may be felt by a significant proportion of the European populace. These percentages seem high and it is not clear to what age groups they apply and to what product groups; further details of the study would be required to verify these figures.

In the professional market, Colipa/FEA expect the proposed option to result in a drop in total sales as compliant alternatives do not offer the same functional properties, and in particular quick drying properties. Colipa/FEA emphasise that for professional applications, the use of quick-drying and fine-spraying hair-sprays is indispensable to achieving special styling techniques. AFC/BiPRO/DFIU [EC, 2002] also confirm functional disadvantages of water-based products, which may have a long drying time and may 'destroy' the hairstyle.

It is also noted by Colipa/FEA that some alternative hair styling products (mouse/foam aerosols, gels and waxes, liquid lotions, creams, gels and waxes) may not be suitable substitutes as they are intended for a different target group; by means of example, they may not be suitable for long hair.

In addition, it is expected that the use of DME instead of propane/butane will increase unit production cost by 15%[86] and Colipa/FEA argue that this increase will be reflected in end-product price. However, the change in price of alternatives to non-compliant products is envisaged by Colipa/FEA to be between 1-2.5%, possibly indicating that in fact not the whole increase in production cost would be passed onto the consumer or that the increase in unit production costs would only represent a relative small percentage of total per unit costs (when other costs aspects are included).

14.9.5.3. Impacts on specific countries/regions

As indicated earlier, aerosol filling is concentrated in several Member States (UK, Germany, the Netherlands, and France) and the impact of this option is likely to be larger in these countries when compared with other Member States

[86] DME is reported to be 50% more expensive than propane/butane.

(Colipa/FEA) (although the Netherlands is unlikely to be affected to the same degree as aerosol production may be dominated by non-cosmetic products).

14.10. Social Impacts

14.10.1. Health Impacts

The implementation of the scenario for option 12b will result in a reduction of anthropogenic VOC emission which may result in a marginal reduction of average ground level ozone concentration in EU-27, Croatia and Turkey. For 12b, only one VOC-reduction scenario has been analysed. In the following table the modelled effects on human health due to this change in the air quality are shown. For the calculations average meteorological conditions and the 2020 reference emission scenario have been used. The figures in the table take into account that the VOC reductions within EU-27+2 will also change the exposure of population in neighbouring countries (total Europe, EMEP grid). By considering only the impacts within EU-27 and Croatia/Turkey, the externalities will decrease. E.g. for option 12b in 2020 the avoided external costs are €833,496.

Table 127: Health benefits in 2015 and 2020 for option 12b due to reduction of VOC emissions related to ground level ozone reduction

		2015	2020
Reduced external costs	[€_00][87]	1,062,858	1,076,328
Mortality	YOLL	7.602	7.699
Morbitity RHA, ages over 65	cases	4.30	4.36
MDR, ages 18-64	days	17,176	17,394
RMU by adults	cases	6,239	6,319
RHA = cases of restricted hospital admissions; MDR = restricted activity days and RMU = cases of respiratory medication use, YOLL = Years of Life Lost.			

14.11. Environmental Impacts

The reduction of VOC emissions may reduce the ground level ozone concentration in Europe. The correlation between the VOC emission reduction and ozone concentration is a non-linear and it is influenced by a number of parameters, e.g. the NO2 background concentrations and the meteorological conditions have a relevant impact on the processes. The region or country where the VOC emissions are reduced have as well a relevant impact on the European wide changes in the ozone concentration.

[87] The monetary values reported in this table are expressed in Euro on the basis of the value of the Euro in the year 2000. The estimation of the monetary values expressed in Euros of 2000 enables a comparison of the monetary values estimated for 2015 and 2020.

The impacts of option 12b on the ground level ozone concentrations are shown in the following table. For the calculations average meteorological conditions and the reference emission scenario for 2020 have been assumed. The impacts of the option have been assessed for the years 2015 and 2020.

Table 128: Impact of option 12b on the average ground level ozone concentration within EU-27 + Croatia and Turkey.

	average O3 concentration [ppb]	
	changes in [ppb]	percental changes
2015	0.001	0.002%
2020	0.001	0.002%

The ozone reduction may also contribute to prevent part of the production losses due to crop damage. The respective results of a VOC reduction due to the new regulation as proposed were calculated for option 12b to be €548,166 for 2015 and €555,859 for 2020.

14.12. Summary of Impacts

Table 129 provides a summary of the main impacts of Option 12b.

Table 129: Option 12b - Summary of Impacts

Impact/Stakeholder	Manufacturers	Professional Users	Consumers	Member State Authorities
Economic				
Capital/investment costs	-			
Operating costs	-			
Product and raw material prices	--	-	-	
Imports/exports	-			
Competition	- (SMEs)			
Innovation/research				
Product performance		--	-	
Monitoring/Surveillance costs				--
Environmental				
Cross media	-/?			
Waste and recycling	0			
Fuel consumption vehicle emissions	0			
Use of renewable/non-renewable resources	+/-			
Key: 0 = no impact +/- = uncertain impact positive or negative -/? = likely slightly negative impact but unquantifiable due to lack of data + = Positive impact ++ = Strongly positive impact - = Negative impact -- = Strongly negative impact Note: Member State monitoring costs refer to Options 12a, 12b and 12c being adopted simultaneously.				

14.13. Description of the Option and Background Information (Option 12c: Introduction of compulsory labeling stating the VOC content on deodorants/antiperspirants and hairsprays)

This option considers the introduction of an obligation for producers of deodorants/antiperspirants and hairsprays to place a clearly visible label stating VOC content on the front of each product. Following a proposal of Colipa and FEA [Colipa/FEA, 2009a], deodorants and antiperspirants are defined as follows:

- **Antiperspirant**: product which is used to control malodour and reduce perspiration in the human axilla.
- **Deodorant**: product, with 3 % or less fragrance, which is used onto the human axilla or body to provide a scent and/or minimize odour.
- **Hairspray:** product which is used to provide sufficient rigidity, to hold, retain and/or finish the style of the hair for a period of time.

Current labeling requirements for cosmetic products arise from Article 6 of the Cosmetics Directive (Directive 76/768/EEC). In addition, aerosol products are subject to labeling requirements stemming from the Aerosol Dispenser Directive (Directive 75/324/EEC).[88] Article 6(g) of Directive 76/768/EEC[89] also requires cosmetic products to detail the list of their ingredients, in descending order of weight at the time they are added, with ingredients representing less than 1% by weight being allowed to be listed in any order at the end of the list.[90] Ingredient listings use the International Nomenclature of Cosmetic Ingredients (INCI) which aims to provide a harmonized name for each cosmetics ingredient (RPA, 2007). No quantitative information on chemical composition has to be given on the packaging of the product. According to Colipa/FEA, Directive 76/768/EEC also provides for on-demand access to more detailed information, including selected quantitative information.[91]

However, it is doubtful that current labeling requirements can be seen as an effective tool in allowing (or influencing) the consumer to purchase a low-VOC product as quantitative information on VOC content is currently not available at the point of purchase. The study team is also not aware of any voluntary labeling of VOC content in cosmetics and no such examples were raised by consulted industrial associations. The current proposal can thus be seen as representing a step change in offering consumers environmentally relevant information that is currently unavailable to them at the point of purchase.

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[88] Aerosol Dispenser Directive (Directive 75/324/EEC) amended by Directive 94/1/EC and Directive 2008/47/EC.

[89] Directive 76/768/EEC consolidated version including amendments up to April 2008. see EurLex Internet Site, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1976L0768:20080424:EN:PDF , accessed on 15th May 2009

[90] Article 6(g) of Directive 76/768/EEC also allows "materials used in strictly necessary quantities as solvents or ascarriers for perfume and aromatic compositions" not to be listed.

[91] According to Colipa/FEA, such information may be obtained via a dedicated Internet site http://www.european-cosmetics.info. However, the consultants have not been able to locate the information on this iInternet site.

While consultation on labeling deodorants and antiperspirants was conducted separately from that for labeling hairsprays, the responses provided by consultees were broadly similar for both product groups and presented here jointly.

14.14. VOC and ozone reduction potential

14.14.1. Availability of data

The identification of the potential VOC reductions resulting from compulsory labelling of aerosol-based deodorants/antiperspirants and hairsprays is based on detailed data provided by FEA and Colipa. The data applied for the estimations refer to those figures FEA and Colipa provided for options 12a and 12b. Therefore, the distribution among countries using population data and the extension of data provided for the EU-27 Member States to the EU-27 plus Croatia and Turkey are analogous to the above-mentioned description.

Furthermore, the projection of current data for the years 2010, 2015 and 2020 followed the identical approach as described above using data on population development provided by EuroStat.

14.14.2. Description of scenarios and estimation of reduction potentials

The reduction potential for each country of the EU-27+2 was estimated comparing the VOC emissions from a "business-as-usual" (BAU) scenario without regulatory changes and four different DECOPAINT-NEW scenarios where the effect of re-labelling of the different products has been analysed. The scenarios are described in more detail in this chapter.

14.14.2.1. Business as usual scenario (BAU)

In the BAU scenario a case without new regulatory measures concerning the labelling of products being introduced to the market is examined. As for options 12a and 12b, the estimation of the BAU scenarios for 2010, 2015 and 2020 is based on data on national population growth.

14.14.2.2. DECOPAINT-NEW scenario for option 12b

For the DECOPAINT-NEW scenarios, data on sales has been extrapolated analogously to the BAU scenario. Again, the time for implementing new regulatory measures in 2010 has been assumed to be too short and no estimation of possible reduction effects in VOC emissions has been estimated.

For 2015 and 2020 the implementation of compulsory labelling of products stating the VOC content has been analysed. The main assumption underlying these assumptions refers to the change in consumer behaviour. It has been assumed that the statement of high VOC contents will lead to a shift of consumption to products including lower amounts of VOC. This shift was assumed to affect current consumption to a certain percentage. Four different scenarios have been regarded: a shift in consumption by 10% (scenario a)), 20% (scenario b)), 30% (scenario c)) and 40% (scenario d)).

For hairspray products these assumption mean a shift by 10%, 20%, 30% or 40% away from products with 95% VOC to products with 90% or less VOC. For deodorants the assumption leads to a 10%, 20%, 30% or 40% decrease in consumption of aerosol-based spray deodorants and antiperspirants as well a as a decrease in demand for sticks and pumps. These decreases are absorbed by increasing consumption of alcohol-type and emulsion-type roll-ons. The demand for creams and gels has been assumed to remain stable. Table 130 shows the reduction potential of this labelling option for each of the EU-27 Member States plus Turkey and Croatia.[92]

[92] The reduction potentials are based on the assumption of an emission factor of 0.95. The factor says that not all of the VOC content is emitted but 5% of the VOC remain in the container and are not released into the air. This factor was agreed by experts during the compilation of the German emission inventory.

Table 130: VOC reduction potentials from compulsory labelling of products (Option 12c)

Country	2015				2020			
	scenario a	scenario b)	scenario c)	scenario d)	scenario a)	scenario b)	scenario c)	scenario d
	kt	kt	kt	kt	kt	kt	kt	kt
Austria	0.18	0.36	0.54	0.72	0.18	0.37	0.55	0.74
Belgium	0.23	0.47	0.70	0.93	0.24	0.48	0.72	0.96
Bulgaria	0.08	0.16	0.23	0.31	0.08	0.15	0.23	0.30
Cyprus	0.01	0.02	0.03	0.04	0.01	0.02	0.03	0.04
Czech Republic	0.11	0.22	0.33	0.44	0.11	0.22	0.33	0.45
Denmark	1.73	3.46	5.18	6.91	1.72	3.44	5.16	6.88
Estonia	0.01	0.03	0.04	0.06	0.01	0.03	0.04	0.06
Finland	0.11	0.23	0.34	0.46	0.12	0.23	0.35	0.46
France	1.36	2.71	4.07	5.42	1.39	2.77	4.16	5.54
Germany	0.12	0.24	0.35	0.47	0.12	0.24	0.36	0.48
Greece	0.24	0.48	0.73	0.97	0.24	0.49	0.73	0.98
Hungary	0.11	0.21	0.32	0.42	0.10	0.21	0.31	0.42
Ireland	0.11	0.21	0.32	0.43	0.11	0.23	0.34	0.46
Italy	1.29	2.57	3.86	5.15	1.30	2.59	3.89	5.19
Latvia	0.02	0.05	0.07	0.09	0.02	0.05	0.07	0.09
Lithuania	0.03	0.07	0.10	0.14	0.03	0.07	0.10	0.14
Luxemburg	0.01	0.02	0.03	0.04	0.01	0.02	0.03	0.05
Malta	0.00	0.01	0.01	0.02	0.00	0.01	0.01	0.02
Netherlands	0.35	0.71	1.06	1.41	0.36	0.71	1.07	1.43
Poland	0.40	0.80	1.21	1.61	0.40	0.80	1.20	1.60
Portugal	0.23	0.46	0.69	0.92	0.23	0.47	0.70	0.94
Romania	0.22	0.45	0.67	0.89	0.22	0.44	0.66	0.88
Slovakia	0.06	0.11	0.17	0.23	0.06	0.11	0.17	0.23
Slovenia	0.02	0.04	0.07	0.09	0.02	0.04	0.07	0.09
Spain	1.04	2.09	3.13	4.17	1.08	2.16	3.24	4.32
Sweden	0.20	0.40	0.61	0.81	0.21	0.42	0.62	0.83
UK	1.35	2.69	4.04	5.39	1.39	2.77	4.16	5.55
EU-27	9.64	19.27	28.91	38.55	9.77	19.55	29.32	39.09
Croatia	0.05	0.10	0.14	0.19	0.05	0.10	0.15	0.20
Turkey	0.76	1.51	2.27	3.03	0.77	1.53	2.30	3.07

14.15. Economic Impacts

14.15.1. Impact on Manufacturers

The response provided by Colipa/FEA indicates that, provided a sufficient transition period is included in the legislation, costs of labelling may be negligible to manufacturers. It was noted that it was unlikely that labelling costs would force companies to discontinue production or significantly increase start-up costs for new market entrants.

The costs that would arise from this option include artwork development, measurement of VOC content, and development and production of different language versions of the label. It is noted that for the vast majority of products, inclusion of a VOC label would only be possible after removing existing text, in particular if this option were to introduce a requirement for the label to include a narrative statement.

PZPK estimates that labelling change may result in a one-off cost of between €500 – 1000 per product[93] indicating that the total cost for each company depends on the size of its product range. Due to the need to produce different language versions of the label, the overall cost may also depend on the geographical area to which a company's products are distributed (this would not apply if legislation required a symbol-based label only). Again, however, it must be recognised that labels are changed on a regular basis and that companies can minimise costs by managing changes in artwork etc to correspond with changes in marketing and promotional activities.

Consultees highlighted three further issues. These include a disproportionate impact on SMEs (further elaboration of why this may be the case is required) and the need for this option to be based on a widely agreed method of determination of VOC content. In addition, Colipa/FEA suggest that due to limited space on cosmetics labels, multi-country labels will have to be replaced by more country-specific labels and in some cases the associated costs may result in companies withdrawing a product from certain Member States; however, no examples of countries that may be affected by this were provided.

14.15.2. Impact on Consumers

While the proposed measure would give consumers the means to base their purchases on environmental considerations, Colipa/FEA note that additional information may overburden the label and confuse the consumer. In this respect, it was suggested that a symbol-based label would be preferable to a narrative-based label.

14.16. Social Impacts

14.16.1. Health Impacts

The implementation of compulsory labelling in option 12c will result in a reduction of anthropogenic VOC emission which may result in a marginal reduction of average ground level ozone concentration in EU-27, Croatia and Turkey. For option 12c one VOC-reduction scenario has been considered for 2015 and 2020. In the following table the modelled effects on human health due to this change in the air quality are shown. For the calculations average meteorological

[93] Upon clarification with PZPK, the study team concluded that the term 'product' equates to a 'formulation.'

conditions and the 2020 reference emission scenario have been used. The figures in the table take into account that the VOC reductions within EU-27+2 will also change the exposure of population in neighbouring countries (total Europe, EMEP grid). By considering only the impacts within EU-27 and Croatia/Turkey, the externalities will decrease. E.g. for option 12c (scenario a)) in 2020 the avoided external costs are €1,484,202.

Table 131: Health benefits in 2015 and 2020 for option 12b due to reduction of VOC emissions related to ground level ozone reduction

		2015				2020			
		Scenario a)	Scenario b)	Scenario c)	Scenario d)	Scenario a)	Scenario b)	Scenario c)	Scenario d)
Reduced external costs	[€_00][94]	1,922,013	3,844,026	5,766,039	7,688,052	1,949,358	3,898,717	5,848,075	7,797,433
Mortality	YOLL	13.747	27.495	41.242	54.990	13.943	27.886	41.829	55.772
Morbitity RHA, ages over 65	cases	7.78	15.56	23.35	31.13	7.89	15.79	23.68	31.57
MDR, ages 18-64	days	31,061	62,121	93,182	124,242	31,502	63,005	94,507	126,010
RMU by adults	cases	11,283	22,566	33,849	45,133	11,444	22,887	34,331	45,775
RHA = cases of restricted hospital admissions; MDR = restricted activity days RMU = cases of respiratory medication use, YOLL = Years of Life Lost.									

[94] The monetary values reported in this table are expressed in Euro on the basis of the value of the Euro in the year 2000. The estimation of the monetary values expressed in Euros of 2000 enables a comparison of the monetary values estimated for 2015 and 2020.

14.17. Environmental Impacts

The reduction of VOC emissions may reduce the ground level ozone concentration in Europe. The correlation between the VOC emission reduction and ozone concentration is a non-linear and it is influenced by a number of parameters, e.g. the NO2 background concentrations and the meteorological conditions have a relevant impact on the processes. The region or country where the VOC emissions are reduced have as well a relevant impact on the European wide changes in the ozone concentration.

The impacts of option 12c on the ground level ozone concentrations are shown in Table 132. For the calculations average meteorological conditions and the reference emission scenario for 2020 have been assumed. The impacts of the option have been assessed for the years 2015 and 2020.

Table 132: Impact of option 12c on the average ground level ozone concentration within EU-27 + Croatia and Turkey.

	average O3 concentration [ppb]	
	changes in [ppb]	percental changes
Scenario a)		
2015	0.001	0.004%
2020	0.001	0.004%
Scenario b)		
2015	0.002	0.007%
2020	0.002	0.007%
Scenario c)		
2015	0.003	0.011%
2020	0.003	0.011%
Scenario d)		
2015	0.004	0.015%
2020	0.004	0.015%

The ozone reduction may also contribute to prevent part of the production losses due to crop damage. The benefit of the VOC reduction due to the new regulation as proposed by option 12c has been quantified. The results are summarised in the table below.

Table 133: Summary of benefits with respect to prevented crop damages by option 12c within EU-27 + Croatia and Turkey.

	scenario a)	scenario b)	scenario c)	scenario d)
2015	989,996	1,979,993	2,969,989	3,959,986
2020	1,005,570	2,011,140	3,016,710	4,022,280

14.18. Summary of Impacts

Table 134 summarises the main impacts of Option 12c.

Table 134: Option 12c - Summary of Impacts

Impact/Stakeholder	Manufacturers	Consumers	Member State Authorities
Economic			
Capital/investment costs	-		
Operating costs	-		
Product and raw material prices	-	0	
Imports/competitiveness	0		
Monitoring/Surveillance costs			--
Social			
Employment	0		
Consumer Choice		++ (VOC information) - (product unavailable in some Member States)	
Environmental			
Cross media	0		
Waste and recycling	0		
Fuel consumption vehicle emissions	0		
Use of renewable/non-renewable resources	0		
Key: 0 = no impact +/- = uncertain impact positive or negative -/? = likely slightly negative impact but unquantifiable due to lack of data + = Positive impact ++ = Strongly positive impact - = Negative impact -- = Strongly negative impact Note: Member State monitoring costs refer to Options 12a, 12b and 12c being adopted simultaneously.			

Annex 15

15. Cleaners – Technical background information (Option 13)

15.1. Information collection on cleaning products

Just like cosmetic products, cleaning products and their VOC emissions have been covered in the following two studies:

- a screening study commissioned by the European Commission [EC, 2002];
- a study commissioned by the Dutch ministry of environment, covering the Netherlands and Belgium [IVAM, 2005].

The EC-2002 study covers EU-15.

The European industry association A.I.S.E. has been contacted in order to explore their ability to provide statistical data, and data on the average VOC content of the various product types. A very limited amount of data was received.

Additional data collection was undertaken by REC in Central and Eastern European Member States, Croatia and Turkey (see separate REC report).

15.1.1. Description of the product group

Similar to the product group of cosmetics the group 'cleaning products' contains a wide variety of product types. Table 135 presents the classification in main categories that is used by the European manufacturers' association A.I.S.E. in their market statistics. As far as possible, the number of subcategories for each main category is presented as well.

Table 135: A.I.S.E. main categories of cleaning products

Category	No. of subcategories described
Household products:	
1. Fabric washing	~ 5
2. Hard surface cleaners	4
3. Dish cleaning	> 3
4. Maintenance products	> 8
5. Soaps	2
6. Bleaches	5
Industrial & institutional	
1. Technical cleaning	> 15
2. Kitchen & catering	> 13
3. Food & Beverage	> 17
4. Building Care	> 20
5. Laundry	> 17
6. Other	> 4

[A.I.S.E., 2008b]

In total, A.I.S.E. distinguishes more than **27** product categories in the household sector, and more than **86** product categories in the industrial and institutional sector, although some categories overlap with household categories. The 'institutional' sector includes cleaning of offices, schools, kitchens, hospitals etc.

A considerable part of the industrial cleaning products are not relevant within the framework of the revision of Directive 2004/42/EC, because they are used inside installations that are in scope of the Solvent Emissions directive.

This is the case for, for example, metal cleaning and metal treatment agents, products for cleaning cars or aircraft, products for cleaning installations in the food industry etc. In addition, a large number of products is not relevant because they do not contain, or hardly any, VOC. This is the case with e.g. soaps, swimming pool hygiene products, washing powder detergents etc. Therefore, a number of products with potential relevance in terms of VOC emissions have been 'pre-selected'.

This was done in the study of IVAM [2005], in cooperation with the Dutch association of cleaning product manufacturers NVZ. Because it has appeared that A.I.S.E. does collect only statistical 'value' data, and only on the aggregated level of the few main categories presented in Table 135, the IVAM study was used as a start. A.I.S.E. provided additional estimates on 3 product categories.

15.1.2. VOC emissions due to cleaning products

Table 136 presents the products selected for the VOC emission estimates, and the results. Below, the methodology will be explained.

Statistical (market) data on product use

Similar to the cosmetics case, the European and national associations do not collect data on volumes or tonnages. A.I.S.E. collects data on the 'value' (in euros) for each of the main categories, and covers EU-27 plus Norway and Switzerland. In the IVAM-study however, more detailed data were collected in cooperation with the national association – added with a few PRODCOM figures. For many product categories however, no statistical consumption data were available, but only estimates of the VOC emissions from other sources. The literature sources involved can be found in the IVAM study [2005]. For only 9 product categories (out of 26) data were available as 'tonnage used'. The Dutch statistics have been extrapolated in two ways:

- simply by the number of inhabitants;
- by the number of inhabitants, corrected with the relative 'per capita consumption' that is known from the *cosmetics* statistical data as provided by Colipa.

Both extrapolations may be compared with industry data for 2 product categories only, because both types of estimates are only available for 2 product groups (window cleaners and air fresheners). In addition it has to be stated that similar assumption were made as in the cosmetics case:

- average VOC contents are roughly equal throughout the EU-27 for each product category;
- emission factors per product category are similar throughout the EU-27;
- product consumption is similarly distributed over the product categories in ll countries;
- for the extrapolation by ‘per capita consumption’: selling prices per kg of product are similar throughout the EU-27.

Average VOC content per product type

VOC in cleaning products may have several functions: propellant in aerosol-type products (e.g. air fresheners), the solvent that mixes and dissolves the various ingredients, degreasing agent, fragrance, and the ingredient that enables quick and seamless drying (e.g. in window cleaners).

The VOC content of cleaning product categories shows a wide range. Accurate statistical data fail in most cases. However, it is obvious that the VOC content ranges from about 1% for e.g. machine dishwash products and washing powder (mainly the fragrance) to about 95% for aerosol-type air fresheners or specific stain removing products. In some cases, the data are hard to interpret because a specific product type includes a range of subtypes. This is the case for air fresheners, for example (see 15.1.3, page 213). In this chapter, the information on the VOC content of the various product types has been based on the IVAM [2005] study, which in turn was collected with the help of industry and existing studies.

Emission factor per product type

Among the cleaning products, relatively many products exist for which not the entire content of VOC will evaporate during or after its use. With dishwashing products or washing powders for example, relatively large shares of the VOC will escape to the sewage system. This justifies the definition of emission factors (<1) for each product type. In this chapter, the emission factors that were developed in the IVAM-study have been adopted.

15.1.2.1. Rough estimate of VOC emissions

Similar to the cosmetics case (chapter 13.1.3) the inventory of the Dutch market prepared in 2005 [IVAM, 2005] has been taken to arrive at a first rough estimate of the total VOC emissions due to the use of cleaning products in the EU, as well as of the VOC emissions per product group. The extrapolation from the Dutch data have been carried out in two ways, as it has appeared that it is not yet certain which way is the most reliable (see cosmetics: 13.1.1 and 13.1.2):

- extrapolation based on the number of inhabitants only;

- extrapolation based on the number of inhabitants and the ´relative per capita consumption´ in euros in the EU-27, as provided by Colipa (only for the total and the most contributing product types).

Obviously, the per capita consumption data provided by Colipa are valid for cosmetic products only. However, as no other reliable data is available; these data have been used for cleaning products as well, in order to present at least one first estimate. Furthermore, similar assumptions have been used as presented in the chapter on cosmetics.

Table 136 presents the results of the estimates. **Total VOC emissions from the use of cleaning products** for the EU-27 have been roughly estimated at **224 kt** (inhabitants & per capita consumption extrapolation) to **308 kt** (only inhabitants' extrapolation). This equals to **15 to 21%** of the total VOC emissions from 'solvent use' (cat. 3D, 1473 kt).

Table 136: Outcome of rough VOC emission estimate for cleaning products

Product category	Product use (kt)*	VOC content (%)	VOC use** (kt)*	Emission factor	VOC emission (kt)*	VOC emission (kt)***
Methylated spirit		85		0,38	22	16
Stain remover (´benzine´)		100	11	1	11	8
Glass/window cleaner		5 - 20	11	1	10	8
Hand cleaner		20-80 (ethanolic)	13-22	0,5/0,83**	11	8
Air freshener		0 – 95	56	1	56	41
Carpet cleaner			1,5	1	1,5	
Washing powder detergent	1106	1	12	0,05	0,6	
Liquid detergent	1166	9	120	0,05	6,0	
Other textile care products	688	3	24	0,05	1,2	
Machine dishwash	269	1	6	0,05	0,3	
Manual dishwash	508	7	42	0,05	2,1	
Machine dishwash – auxilliary products	257	1	2	0,05	0,1	
Bleach product	640	1	7	0,45	3,3	
Scouring agents	114	4	6	0,05	0,3	
Universal cleaning product	568	10	63	0,10	6,3	
Graffitty remover/ facade cleaning products			3	0,85	2,7	
Car wax			4	0,85	3,6	
Car plastic care product					6,6	
Car window (windscreen) cleaner		5-33			90	66
Car de-icer					9,0	
Bathroom and kitchen mousse					0,6	
Oven cleaner					0,3	
Disinfectant		70 – 90 (ethanol)			38	28
Metal polish			13	0,85	11	8
Leather and shoe maintenance products		25 - 75			11	8
Furniture maintenance products					4,5	
TOTAL					308	224

*Extrapolation The Netherlands' data by inhabitants

**Extrapolation of The Netherlands' data by inhabitants & per capita

***consumers & professionals

****emission factor for consumers and professional differ, because product type & use differ

based on [IVAM, 2005]

Most contributing product groups include car window cleaners (66 to 90 kt), air fresheners (41 to 56 kt) and disinfectant (28 to 38 kt) and methylated spirit (16 to 22 kt). Additionally, glass or window cleaning products, stain removers, hand cleaners and leather and metal maintenance products each have about 8 to 11 kt. However, the picture is rather ´blurred´ because:

- at least in the Netherlands, ´methylated spirit´ (denatured ethanol) is used as window cleaning product as well, but also for other purposes, such as fuel for cooking equipment. Thus, part of the methylated spirit emissions add up to ´window cleaning product´;
- the product group of ´air fresheners´ involves many subtypes, each having very different VOC contents. The relative market share of each type is not known. The same holds for hand cleaners and disinfectants, although ethanol (-containing) products probably account for most of the VOC emission.

15.1.2.2. Comparison of the rough estimates to estimates from other sources

In order to make comparisons, the following estimates can be used:

- statistics provided by A.I.S.E. [A.I.S.E., 2008a]
- FEA (aerosol industry) data [FEA, 2008]
- The EC-2002 study of ATC/BiPRO/DFIU [EC, 2002].

A.I.S.E. statistics

A.I.S.E. has collected statistical data among their industrial members (individual companies). Statistical data on amounts used are normally not collected by A.I.S.E. and are not available on the individual Member State level. These statistics cover 95% of the EU-27 market [A.I.S.E., 2008a].

Unfortunately, the data that are available involve only three product categories, and only two of these were covered by the IVAM-inventory as well. A.I.S.E. has no data on car window cleaners and methylated spirit as the suppliers of these are not represented by the association.

In fact, the market for car products is very diffuse, involving for example specialised car product stores as well as general warehouses and supermarkets. The latter also supply methylated spirit. For many other product groups, A.I.S.E. has no data because of the very diffuse, fragmented markets. A.I.S.E. has provided the following estimates:

Table 137: A.I.S.E. statistics on VOC emissions from three product groups (EU-27), base year 2007

Product category	VOC use (assumed emission factor = 1; from [IVAM, 2005])
Air fresheners (all types)	35.6 kt
Glass and window cleaners (non aerosol)	6.6 kt
Insecticides (aerosol)	4.8 kt

[A.I.S.E., 2008a]

FEA data

The FEA market statistics 2006, providing the number of units (spray cans) produced for *aerosol-type* products can be used to prepare comparative estimates of the VOC emissions involved. As stated in chapter 6.8.2.2, these statistics cover only 18 countries. When using similar assumptions as used in chapter 6.8.2.2, estimates for the product groups of aerosol-type air fresheners and insecticides (the two largest product groups) have been made:

Air fresheners – aerosol-type:

European production: 490,493 million units. Average contents: 400 ml. Average VOC content: 95%. Average density: 0.75 kg/l. Product use estimated: $0.49x10^9$ x 0.4 x 0.75 kg = (/ 10^6) 147 kt.

VOC emission estimated: 95% x 147 kt = 140 kt

"Insecticides & plant protection products" (aerorols)

European production: 232,956 million units. Average contents: 400 ml (also smaller units?), average VOC content 95%, average density 0.75 kg/l. Product use estimated: $0,23.10^9$ x 0.4 x 0.75 kg = (/ 10^6) 69 kt.

VOC emission estimated: 95% x 69 kt = 65 kt.

EC-2002 study

The EC-study [EC, 2002] arrived at a rough estimate of total VOC emissions from cleaning products of 600 kt, among which 300 kt from industrial cleaning (base years around 2000). If industrial cleaning is subtracted (these were not included in the IVAM study neither), a total of 300 kt remains for EU-15 in 1999.

Taking into account that EU-15 population in 1999 was 306.233 Mio compared to 317.861 Mio in 2006 (+3.8 %), VOC emission of 2006 based on 300 kt in 1999 would be 311.4 kt. EU-27 population in 2006 was 492.975 Mio or 155.1 % of EU-15. Assuming a similar cosmetics consumption of each inhabitant in New Member States like in EU-15, VOC emission of cosmetics in 2006 would be **493 kt**.

Assuming that cleaners' market in New Member States has per capita about 50 % of volume compared to EU-15 (compare cosmetics), the factor to calculate from EU-15 to EU-27 may be 122.6 % instead of 155.1 %, resulting in total VOC emissions in 2006 of about **382 kt**.

It is not entirely clear how many and which product groups were included. Moreover, the base year differs from than in the IVAM study. Therefore, it is hard to compare both estimates.

Only for a few product groups, comparisons of the estimates can be made. The variations in the coverage of Member States and the various assumptions described above have to be taken in mind.

Table 138: VOC emission estimates for cleaning and household products from various sources

Source	air fresheners	Glass/window cleaners	Insecticides
IVAM 2005 (extrapolated)	66 – 90 kt (all)	8 – 10 kt? (+ unknown share of ´methylated spirit´: 16-22 kt)	-
A.I.S.E. (EU-27)	35,6 kt (all)	6,6 kt	4,8 kt
FEA (EU-18?)	140 kt (only aerosol-type)	-	65 kt

[A.I.S.E., 2008a] [FEA, 2008] [IVAM, 2005]

It seems that the extrapolations made from the FEA statistics on ‘numbers of units’ produced are too high. This may be caused by various assumptions made, e.g. the average content of the units. The higher estimates of IVAM might be partly explained by a higher ‘per capita consumption’, although at the lower end of the range presented this has been taken into account already (by applying a correction factor of 115/158, representing relative per capita consumptions for cosmetics – as for cleaners this data is not known – in EU-27 and the Netherlands, respectively). Nevertheless, it appears that the product group of ‘air fresheners’ is a major contributor to VOC emissions. However, this group involves 7 subtypes of products. This will be further dealt with in the following chapter.

15.1.3. VOC reduction options and reduction potential

Because of the large number of product (sub-) types (> 110) it will be impossible – similarly to the cosmetics case – to define and enforce VOC limits for each individual product group. Besides, many of them have a limited relevance in terms of VOC emissions. Therefore, any proposed VOC limit should focus on those product types that contribute most to emissions and/or allow cost-effective reduction options.

In this chapter therefore, the focus will be on the product groups of air fresheners, car window cleaners, household glass and window cleaners (including methylated spirit), and shortly disinfectants and insecticides.

15.1.3.1. Air fresheners

Air fresheners are products that provide a pleasant fragrance to a room, or to mask an unpleasant smell. The product group of air fresheners appeared to be very diverse. The following product types are on the market [A.I.S.E., 2008a] [IVAM, 2005]:

- conventional aerosols with liquid propellants ("double phase and single phase"; 90-95% VOC);
- pump sprays/ pressing flacons (± 80-95% VOC);
- perfumed candles (no VOC)
- liquid wick (VOC content not known)
- gels (no VOC)
- electrical devices (5-30% VOC)
- car fresheners (90-95% VOC, if aerosol-type).

Basically, two types of air fresheners should be distinguished [IVAM, 2005]:

- 'instant' air fresheners, which distribute the fragrance quickly, in order to mask an unpleasant smell, e.g. in toilets; these are available as aerosols (with propellant), nebulizers (pump sprays) or 'pressing flacon';
- continuous air fresheners, which provide a continuous, low-level 'background' scent, e.g. in living rooms; these are available as gels or 'electric' air fresheners; scented candles and incense may be regarded as continuous air fresheners as well.

As far as VOC emissions are concerned, the first type – *instant air fresheners* – is the most relevant one. There are no data on the actual market shares of each type. Current VOC emissions of all types together probably range from 35 to 56 kt (chapter 15.1.2). As far as the aerosol-type is concerned, which probably accounts for most of the VOC emissions EU-wide, similar alternatives may be present as those for hairspray and deodorant aerosols:

- concentrated or water-containing aerosol (80-90% VOC)
- pump sprays (80-95% VOC).

Although largely similar objections against these alternatives have been mentioned as in the hairspray and deodorant cases [IVAM, 2005] the impression exists that pump sprays have relatively larger market shares among air fresheners, at least in Western Europe. However, a considerable amount of solvent and/or propellant is needed to ´lift´ the fragrance [IVAM, 2005]. According to industry, aerosols with liquefied propellants have a better performance than mechanic systems (pump sprays and pressing flacons), because in the latter the droplets are too large, i.e. the spray is too "wet" [Halleux & Pfeifer, 2005]. Thus, the VOC reduction potential would be very limited.

With respect to the ‘*continuous*’ air fresheners, some specific comments can be made. Air freshening gels are water-based, VOC-free products, while ‘electricals’ contain 5 % to 30 % of VOC [IVAM, 2005]. Thus, a shift to gels could mean a 100 % reduction of the VOC emissions from continuous air fresheners. However, the current contribution of continuous air fresheners to VOC emissions is not known. Earlier studies concluded that the two product types are not completely exchangeable [CREM, 2000], because “electricals” have several advantages:

- they can be used in large rooms as well (gels have a limited ‘effective working area’);
- the supply of air freshener can be adjusted;
- they can be turned off.

On the other hand, electric air fresheners can only be used in rooms where a spare power point is available. Besides, it was observed that refill cartridges for electric air fresheners are 4 times as expensive as gels. The difference in working time was smaller: 1.5 times as long with electric air fresheners. Despite the higher price, the use of electric air fresheners has been growing. Therefore, the authors of the CREM study concluded that consumers feel that electric air fresheners provide an ‘additional value’. This was also suggested by industry [Halleux & Pfeifer, 2005].

Altogether, VOC reduction options for air fresheners are rather uncertain. In particular because current market shares of the various product types are not known.

15.1.3.2. Car window cleaners

Car window - or ´windscreen´ - cleaners are used as cleaning agent and anti-freezing agent in the tank of windscreen washers. Roughly estimated VOC emissions are 66 to 90 kt. In countries in which winter temperatures may fall below zero, ´summer` and ´winter` versions of the products are marketed. The summer versions contain less than 5% VOC, while the winter versions may contain up to 33% VOC [IVAM, 2005]. The latter product types protect the product from freezing until temperatures as low as -20°C. In some cases, the product is marketed as a concentrate, which has to be diluted with water. Concentrates based on ethanol and/or isopropanol may contain up to 90% of VOC, while concentrates based on these solvents as well as ethyleneglycols and propylene glycols may contain up to 40-50% of VOC [CREM, 2000] [IVAM, 2005]. It has been stated that for very low temperature (-20°C) frost protection, the current VOC content of 33% is the lowest achievable already. Only information supply to consumers or marketing restrictions of the ´winter´ varieties in certain periods (summer) or areas (southern) might result in VOC reduction. However, such measures may be hard to define EU-wide.

Marketing restriction of high-VOC ´winter´ products to certain geographic areas

In the USA, the authorities have considered restricting the use of high-VOC car window cleaners to those areas in which winter temperatures fall below zero. However, in Europe only a few areas will be completely 'frost free' in winter. Therefore, this may not be a feasible EU-wide option.

Restriction of marketing the 'winter versions' to the autumn and winter period

Selling the winter version might be restricted to the autumn and winter period. In some cases, retailers already follow this guideline. Moreover, cars that are sold in the summer often contain diluted window cleaning fluids with an isopropanol concentration of ~5 % [Kröse, 2005]. On the other hand, other retailers and repair shops take into account that consumers never change the product and therefore always use the winter version [IVAM, 2005].

Informing the public on the proper use

If a general VOC limit or product restrictions are not feasible, informing the public – e.g. by labelling – may provide some VOC reduction. Some consumers tend to use the winter version all year long to be on the 'safe side', or simply forget to change in springtime. Car repair shops even anticipate this behaviour by always using the winter version, whether the car is in the repair shop for maintenance in winter or in summer [IVAM, 2005]. In this case, an information campaign supported by suppliers, or labelling, may result in some VOC reduction.

Unfortunately, insufficient data are available to estimate the potential VOC reduction of these options. If - *very roughly* estimated - in half of the cases (half of the countries/ covering half of the total number of inhabitants) a restriction of the winter version to 6 months per year would be possible, this may result in a VOC reduction of **5** to **13.6** kt (5 %/33 % x 33 kt to 5 %/33 % x 90 kt).

15.1.3.3. Glass and window cleaners (household) and methylated spirit

Methylated spirit consists of 85 % ethanol in water, with small amounts of methanol and a colouring agent [CREM, 2000]. It is mainly used by consumers, as fuel for the preparation of food and for cleaning (mainly) glass surfaces: mirrors, windows, glass-covered tables etc. Methylated spirit for cleaning purposes is either used undiluted, or diluted in water, sometimes in combination with detergent. In 1994, research among Dutch consumers pointed out that the use of methylated spirit was distributed over the various ways of application as follows [CREM, 2000]:

- cooking (fuel): 26 %;
- diluted cleaning: 62 %;
- undiluted cleaning: 12 %.

In addition to methylated spirit, specifically designed products for window cleaning are on the market. Typical VOC contents of this type of products range from 5 to 20% [IVAM, 2005]. Solvents used include ethanol, isopropanol, butylglycol and butyldiglycol [IVAM, 2005].

Discussions with industry indicate that the VOC content of modern products are closest to 5% [Beij, 2008]. The solvent and the surfactant together take care of removing dirt and greasy contamination. In addition, the solvent takes care of obtaining a glass surface without traces after drying. The products are generally supplied in a spray can and directly applied on the glass. Therefore, most of the solvent will evaporate. As presented, current VOC emissions from designed glass and window cleaners range from 6.6 to 10 kt. If ´Dutch habits´ would be valid throughout the EU, the use of methylated spirit may contribute another 12 to 16 kt (74% x 16 or 22 kt), i.e. in total 18.6 to 26 kt.

Reduction options

The main advantage over water-based cleaning agents without ethanol or other solvents is the fact that a mirror or window does not show traces after drying [IVAM, 2005].

However, because specific glass and window cleaners that are on the market that contain 5 to 20 % of solvent, a limit value of 5 % may be feasible. A further reduction below 5 % would decrease the efficiency of the product (if not enough solvent is used this will result in traces on the windows). This must be avoided, because it could possibly stimulate the consumer to use methylated spirit instead of glass cleaner [Halleux & Pfeifer, 2005]. Detailed figures on the current distribution of products with different VOC percentages are not known. The absolute VOC reduction potential is therefore hard to estimate. Nevertheless, the feasibility of the option is considered high.

The use of methylated spirit, either diluted or not diluted, does not allow realistic options for a product regulation, as there are several other uses of the product.

15.1.3.4. Disinfectants and insecticides

According to industry, disinfectants are almost exclusively used by professionals. In particular disinfection processes that use ethanol are relevant for VOC emissions. Most disinfection activities in e.g. the food processing sector, meat and dairy processing plants, butchers etc. use water-based products with chlorinated active ingredients or quaternary ammonium salts. However, especially in the health care sector, and also in e.g. hairdressing salons, ethanol is widely used. The IVAM report [2005] states that industry had no data on use of disinfectants in the health care sector. In the healthcare sector, ethanol is used for disinfecting [CREM, 2000]:

- small tables etc. in patients' rooms;
- surfaces that are meant to place sterile materials on, e.g. in operating rooms;

- thermometers, blood pressure meters, infusion caps;
- materials in hospital kitchens that cannot be cleaned otherwise.

In hairdressing salons, ethanol is used for disinfecting razors in particular [Terwoert et al., 2001], but also scissors and combs. For large surfaces, ethanol is not used, because of its flammability [CREM, 2000]. The products involved contain 70 - 90 % ethanol in water. Alternatives for ethanol as disinfectants would include chlorinated components and possible hydrogen peroxide. Quaternary ammonium salts are not regarded suitable, because they leave a residue [CREM, 2000]. Reducing the use of disinfectants in healthcare and at hairdressers is probably not very feasible, because of the high hygienic standards that have to be followed. Current VOC emissions from disinfectants have been estimated at 28 to 38 kt (Table 136, page 210).

Reduction options in disinfectants

Two products that are widely used elsewhere may serve as an alternative:

- sodium hypochlorite;
- sodium dichloro isocyanurate (tablets).

Both products are available on the market. The relative emission reduction is (at least theoretically) 100 %. The chlorinated products have the advantage of having a ‘broad spectrum’ of activity, i.e. they are active against many different microorganisms, just like ethanol. In addition, they work quickly and leave no residue. However, the use of chlorinated products has been criticised as well. In particular, the formation of potentially toxic metabolites has been a point of concern. Some chlorinated products are classified as dangerous for the environment. In summary, the following aspects have to be considered [CREM, 2000]:

- chlorinated products are corrosive to certain materials;
- chlorinated products are de-activated by organic materials; therefore, the surfaces should be cleaned prior to disinfecting them; this involves extra (labour) time;
- materials have to be rinsed with water after the disinfection, contrary to the use of ethanol; this involves extra (labour) time as well;
- in contact with acids (e.g. chalk removing cleaning agents), toxic chlorine gas may be formed;
- sodium dichloro isocyanurate tablets have to be dissolved before use.

Because the current relative market shares of chlorinated products and ethanol-based products and the potential market shift are not known, the relative VOC emission reduction potential resulting from a shift from ethanol-based products to chlorinated products cannot be estimated. However, the feasibility is considered low due to major environmental objections to an increased use of chlorinated products.

With respect to *insecticides*, estimates from A.I.S.E. indicated an EU-wide VOC emission of 4.8 kt. This emission originates entirely from aerosol-type products. As further information on current market shares, compared to alternative application manners, fail, little can be said about reduction options. Probably, the reduction potential within the aerosol-type product group is low, similar to the cases of hairsprays, deodorants and air fresheners. One far-reaching option to consider may be a ban of aerosol-type insecticides for consumer use. This might be justified by their hazardous nature as well.

Annex 16

16. Cleaners – Impact Assessment (Option 13)

16.1. Description of the Option and Background Information

This option proposes to include household glass and window cleaning products within the scope of Directive 2004/42/EC. The impact assessment considers the likely impacts of setting limits for VOC content at 3% or 5% and the majority of data (provided by A.I.S.E., the International Association for Soaps, Detergents and Maintenance Products) relates to non-aerosol glass and window cleaners.

16.1.1. Option 13

Current limit values for glass and window cleaners (non-aerosol) on the market are in the region of between 5% and 20% solvent content. Detailed figures on the number of manufacturers in the EU producing glass and window cleaners with different VOC content are not currently known. A.I.S.E. has, however, been able to provide information suggesting a breakdown of sales by volume of products with different VOC contents. These are reflected in Table 139 below.

Table 139: Sales of glass and window cleaners with different VOC content

Glass and window cleaning products...	% of total EU sales of glass and window cleaning products, by volume (tonnes)
...with more than 5% VOC's	42%
...with less than 5% VOC's	58%
...with less than 3% VOC's	6%

From these figures, it is clear that there are already products existing at the lower level which indicates that the possibility to produce low VOC content products is given and that there is a potential to move in this direction. More than half of the products currently on the market already would be compliant with the 5% limit, but A.I.S.E. indicate that moving to the 3% limit would be much more of a challenge for its members.

It should be noted that it has not been possible to even obtain information regarding the total number of manufacturers that are producing glass and window cleaners in the EU, let alone to get specific information on the numbers of firms that are supplying products at the different VOC levels. Consequently, it is difficult to assess the scale of the overall impact of introducing the option on manufacturers. A.I.S.E. have indicated that the current situation is characterised with SMEs tending to produce more products over the 5% VOC limit, which would suggest that imposing the limits set by the option might affect SMEs to a disproportionately greater extent than their larger counterparts.

In general, market growth of the sector is relatively slow and the industry association expects VOC content to either remain constant or decrease slightly in the foreseeable future in the absence of any imposition of VOC limits. This view of the likely development of the market, specifically that aspect related to VOC content, is consistent with some general industry trends towards some products becoming more eco-friendly. An EU-wide eco-label for all-purpose cleaners and cleaners for sanitary facilities is already in existence and whilst not specifically applicable to specialised glass and window cleaners, some products which are used for cleaning glass and windows will fall under the label's coverage. Entitlement to applying the eco-label requires, among other criteria, the product to “not contain more than 10% (by weight) of volatile organic compounds with a boiling point lower than 150 °C”.

No information is available regarding the number of glass and window cleaning products that carry this eco-label. However, it is noted that the relevant criteria will cover fewer VOCs than Directive 2004/42/EC (since it sets a lower boiling temperature) and the 10% limit is also higher than the limit being proposed under this particular option. It is also noted that signing up to the label and meeting its criteria is voluntary.

Should the option be introduced, the impacts that are likely to arise will be as a result of producers being required to reformulate their products or expand existing production capacity of already compliant products. Broad categories of impacts will relate to the cost of doing this, to the reduction in VOC emissions that would likely arise as a result and, potentially, any impacts that might relate to the functionality of products developed with a lower VOC content. These impacts are detailed in the following chapters.

16.2. VOC and ozone reduction potential

16.2.1. Availability of data

The data used for the estimation of the reduction potentials were provided by A.I.S.E., covering the aggregate EU-27 output as well as national amounts of output for 14 countries of the EU-27. Furthermore, the share of sales containing more than 5% VOC, less than 5% VOC and less than 3% VOC were provided by A.I.S.E..

For the estimation of national output data for the additional 15 countries, population data provided by the EuroStat database were applied. The population of those countries were data were available were aggregated and put into relation with the total population of the EU-27. The country-specific shares of the additional countries resulted from the ratio of national population data and the mentioned difference in the aggregate outputs.

These shares in population data were taken to estimate the total output in window cleaners for each of the additional countries. The share of products with different VOC contents provided by A.I.S.E. were used to distribute the total output data among these product types.

For the estimation of national outputs for Croatia and Turkey, the total output of the EU-27 was extrapolated to the EU-27+2 level applying the proportion of population of the EU-27 and the EU-27+2. The extrapolated amount of outputs was distributed among the two countries according to their size of population.

In agreement with experts from A.I.S.E. the average VOC content for those products reporting VOC contents of above 5% was set to 8%, for those outputs containing less than 5% it was assumed to be 4% and for outputs reporting less than 3% a VOC content of 2% was assumed.

16.2.2. Approach of projection for scenarios in 2010, 2015 and 2020

The impact assessment will focus on the developments in the years 2010, 2015 and 2020. Therefore, data on outputs for window cleaners had to be extrapolated to allow for these projections.

The development of the market for window cleaners was assumed to be stable, showing a slow market growth. To account for this growth, the market was assumed to grow with the development of national population. EuroStat provides data on future population growth for each of the EU-27 countries. For the estimation of market growth in Croatia and Turkey, the average population growth for the EU-27 for each of the regarded years has been used.

16.2.3. Description of scenarios and estimation of reduction potentials

The reduction potential for each country of the EU-27+2 was estimated through comparison of the VOC emissions from a “business-as-usual” (BAU) scenario where no regulatory changes will come into play and two DECOPAINT-NEW scenario where the initially mentioned scenarios of reducing the VOC contents in window cleaners will be analysed. The scenarios are described in more detail in this chapter.

16.2.3.1. Business as usual scenario (BAU)

The BAU scenario represents the case where the limits are not further regulated and where the only changes with respect to the base year can be found in the amount of outputs and the VOC emissions resulting from these sales.

The projection for the BAU scenarios into 2010, 2015 and 2020 have been accomplished with the above mentioned approach of applying population growth rates.

16.2.3.2. DECOPAINT-NEW scenarios for option 13

The DECOPAINT-NEW scenarios cover two different regulatory interventions. First, scenario a), the VOC limit will be regulated at 5%, resulting in a shift of all outputs with higher VOC contents to those below this new limit. Second, scenario b), the VOC contents were limited to be maximum 3%, including a shift of all outputs with higher limits into this product group. It has been assumed that both scenarios do not lead to a decrease in total output.

Furthermore, the average VOC contents of the product groups with less than 5% and less than 3% respectively were assumed to be constant.

The following table provides an overview of the reduction potentials for each of the EU-27 Member States plus Croatia and Turkey.[95] For the EU-27 a reduction potential of around 2.5 kt for scenario a) and a reduction potential of around 5.5 kt for scenario b) can be found for 2015 and 2020.

[95] For the estimations of the reduction potential an emission factor of 0.95 was applied. Thus, not all of the VOC content is emitted but 5% of the VOC are assumed to remain in the container and are not released into the air. This factor is based on an agreement of experts during the compilation of the German emission inventory.

Table 140: Reduction potential of option 13 per country, in kt

country	2015		2020	
	Scenario a) kt	Scenario b) kt	Scenario a) kt	Scenario b) kt
Austria	0.04	0.08	0.04	0.08
Belgium	0.05	0.10	0.05	0.11
Bulgaria	0.04	0.10	0.04	0.09
Cyprus	0.01	0.01	0.01	0.01
Czech Republic	0.03	0.07	0.03	0.07
Denmark	0.03	0.07	0.03	0.07
Estonia	0.01	0.02	0.01	0.02
Finland	0.03	0.07	0.03	0.07
France	0.24	0.51	0.25	0.52
Germany	0.38	0.81	0.38	0.80
Greece	0.08	0.16	0.08	0.16
Hungary	0.06	0.13	0.06	0.13
Ireland	0.03	0.07	0.03	0.07
Italy	0.37	0.78	0.37	0.79
Latvia	0.01	0.03	0.01	0.03
Lithuania	0.02	0.04	0.02	0.04
Luxemburg	0.00	0.01	0.00	0.01
Malta	0.00	0.01	0.00	0.01
Netherlands	0.07	0.14	0.07	0.14
Poland	0.19	0.41	0.19	0.41
Portugal	0.04	0.09	0.04	0.09
Romania	0.08	0.17	0.08	0.17
Slovakia	0.02	0.04	0.02	0.04
Slovenia	0.01	0.03	0.01	0.03
Spain	0.29	0.61	0.30	0.63
Sweden	0.06	0.12	0.06	0.13
UK	0.39	0.83	0.40	0.85
EU-27	2.59	5.51	2.62	5.58
Croatia	0.02	0.05	0.02	0.05
Turkey	0.36	0.78	0.37	0.79

16.3. Economic Impacts

16.3.1. Impact on public authorities and public spending

Monitoring and administrative cost

Since there will be a number of new products coming under the scope of the directive, surveillance agents in Member States will likely require some upgrading in their training. Additional costs might also be foreseen in terms of additional testing of the new products falling within the scope of the directive. A number of Member States have indicated that they would expect increases in their costs resulting from the option. (Note that some Member States responded generally, identifying additional costs under "new products", and where this is the case, it is expected that those Member States would incur costs under this option.)

16.3.2. Investment

Capital Investment Incurred Due to New Equipment, Reformulation, Etc,

Given the fact that an estimated 42% of window and glass cleaners currently sold on the market would not be compliant with a 5% VOC limit, reformulation would be required by some companies. The extent of this in terms of how many companies are affected is unknown - it may be that the majority of products that are currently above a VOC limit of 5% are sold by a large number of companies, or alternatively, by a small number of companies. Clearly, if the latter is the case, then reformulation and other investment costs would inevitably be lower than if a larger number of companies were required to make the necessary adjustments. Further research in this area would be required to draw any significant conclusions about the overall scale of any increases in investment costs resulting from the option.

Industry consultees have not been able to provide the study team with any information regarding per product or unit costs for re-formulation to either the 5% or the 3% limit. There is likely to be a difference between the two since currently approximately 58% of window and glass cleaners are compliant with the proposed 5% limit whereas only 6% are estimated to be compliant with the 3% limit (although this may be due to other considerations such as relative performance). Thus, not only would more products and companies be affected at the 3% limit, it may also be more costly in reformulation cost terms.

As mentioned previously, SMEs represent a disproportionate share of the companies formulating products with a VOC content above 5% and, consequently, setting a limit of 5% would impact on SMEs to a greater extent. Unfortunately, the study team has not been able to find any quantitative information regarding the number of SMEs versus the number of large companies producing products that are currently not compliant with the proposed limits.

16.3.3. Impact on Competitiveness and Trade in Relation to Trade with Non-EU Countries

16.3.3.1. Import Penetration

The majority of the EU market for glass and window cleaners is supplied by firms from the EU. A.I.S.E. estimate the market share of EU producers as being close to 100% and anticipate no significant impact as a result of the introduction of either of the limits in terms of the share of the market for domestic producers, implying that foreign producers are in no stronger position in terms of being able to produce compliant products at either the 5% VOC or 3% VOC limits.

16.3.3.2. Competitiveness of EU Companies in External Markets and Exports

EU producers market their products almost solely within the EU market, with only approximately 2% being exported for sale in a third country (A.I.S.E., 2009; figures relate to 2007-2008). It is not expected that the introduction of this particular option would have any marked effect on companies' concentration in the domestic and external markets. However, A.I.S.E. predicts that large companies might engage to some extent in dual production, supplying compliant products to both markets, but also non-compliant products to countries which do not impose the same limits as those that would apply to the EU market.

16.3.4. Impact on Functioning of the Internal Market and Competition

16.3.4.1. Number of Firms (entry/exit rates)

Since SMEs represent an over proportionate amount of companies formulating products with VOC content above 5%, setting a limit of 5% or at 3% would have a wider negative effect on SMEs telative competitive position than on large companies. A.I.S.E. would anticipate that reformulation costs would be too high for many SMEs at the 5% limit.

16.3.4.2. Barriers on New Entrants, Monopolies, Market Segmentation, Special Trade Barriers

A.I.S.E. have estimated that start-up costs for new companies would increase if either the 5% VOC limit or 3% VOC limit were introduced by approximately 2.5% - 5%. No further information on start-up costs has been identified and it is unclear at this point what costs would increase for companies looking to enter this market. The main change that would be required by the limits being set under this option would appear to be reformulation in order to achieve appropriate performance.

16.3.5. Impact on Innovation and Research

A.I.S.E. anticipates that a move towards a 3% VOC limit would hamper progress on innovation towards more efficient and concentrated products. It would require the development of new active systems, involving additional R&D expenditures.

16.3.6. Impact on Operating Costs and Conduct of Businesses (SMEs)

16.3.6.1. Cost and Availability of Essential Inputs

Profit margins within this sector primarily depend on market position, branding etc. (A.I.S.E., 2009 consultation). Consequently, raw material costs have minor impacts on profitability for this particular product category. Once reformulation has been successfully completed to reach the required limits on VOC content, it is therefore unlikely that there will be significant changes in profitability for companies in the sector (although A.I.S.E. have said that raw material costs would increase for overall formulations).

16.3.6.2. Impacts on SMEs

As mentioned above, a greater proportion of SMEs are currently producing non-compliant products with a VOC content of greater than 5%. Clearly this would mean that the need to reformulate products would be imposed upon a greater number of SMEs, involving inherent costs and the possibility that some SMEs would be forced to leave the EU market should the reformulation costs be simply too high. It has not been able to quantify the possibility of this effect to any degree.

16.3.7. Impact on End-users (consumers and professional end-users)

16.3.7.1. Quality/Availability/Consumer Choice

A.I.S.E. are of the opinion that it is technically not feasible to produce household glass and window cleaners with a VOC content below 3% and still maintain product performance. This view implies that the current 6% of products sold on the market that currently meet this limit deliver a significantly lower level of performance, although no information has been supplied to support this type of conclusion. Clearly though, as 58% of the market is made up of products with a VOC of less than 5%, meeting this higher limit would not appear to pose significant performance penalties for most products.

It is of note though that A.I.S.E. highlight that there may be specific cases where performance requirements could not be met. The example provided is that of automotive window cleaners where a high content of VOC (> 60%) is required in order prevent the freezing of the liquid in the tank or on the window when sprayed. It is argued that no technical replacement can be found for this particular type of product.

16.3.8. Impacts on Specific Countries/Regions

A.I.S.E. feel that any impacts on product performance, product price, environmental effects, etc. would be greater in Mediterranean countries since there is more glass and windows (both outdoors and indoors) to clean in these countries. The study team has been unable to verify the extent to which this might be the case and therefore it is not possible to quantify even in percentage terms the greater or lesser extent of certain impacts in some Member States as opposed to others.

16.4. Social Impacts

16.4.1. Health impacts

The implementation of option 13 will result in a reduction of anthropogenic VOC emission which may result in a marginal reduction of average ground level ozone concentration in EU-27, Croatia and Turkey. As described before for option 13, two different VOC-reduction scenarios have been considered for 2015 and 2020 with respect to different VOC limit values. In the following table the modelled effects on human health due to this change in the air quality are shown. For the calculations average meteorological conditions and the 2020 reference emission scenario have been used. The figures in the table take into account that the VOC reductions within EU-27+2 will also change the exposure of population in neighbouring countries (total Europe, EMEP grid). By considering only the impacts within EU-27 and Croatia/Turkey, the externalities will decrease. E.g. for scenario a) of option 13 in 2020 the avoided external costs are €422,904.

Table 141: Health benefits in 2015 and 2020 for option 13 due to reduction of VOC emissions related to ground level ozone reduction.

		2015		2020	
		Scenario a)	Scenario b)	Scenario a)	Scenario b)
Reduced external costs	[€_00][96]	554,125	1,179,615	560,852	1,193,934
Mortality	YOLL	3.963	8.437	4.012	8.540
Morbitity					
RHA, ages over 65	cases	2.24	4.78	2.27	4.83
MDR, ages 18-64	days	8,955	19,063	9,064	19,294
RMU by adults	cases	3,253	6,925	3,292	7,009
RHA = cases of restricted hospital admissions; MDR = restricted activity days RMU = cases of respiratory medication use, YOLL = Years of Life Lost					

[96] The monetary values reported in this table are expressed in Euro on the basis of the value of the Euro in the year 2000. The estimation of the monetary values expressed in Euros of 2000 enables a comparison of the monetary values estimated for 2015 and 2020.

16.4.2. Impact on Employment

Industry associations have been unable to come up with any estimates for the impact of the option on employment in the sector. Since the study has not been able to identify the number of manufacturers of glass and window cleaners, it is also neither possible to quantify the number of employed in the sector nor the number of potential job losses that might result from the option. Assuming that firms do go out of business where they cannot meet the costs of reformulation, there will be some consequential job losses, although it is impossible to predict how many at this point in time. However, the fact that so many products are currently compliant with the proposed VOC limits suggests that the effects are likely to be minimal (at lease for the 5% limit).

16.4.3. Impacts in the workplace

Impacts on specific professions

Window cleaners would be the group most affected by the option. Reductions in VOC content would likely lead to beneficial health impacts, although it is noted that the intention of Directive 2004/42/EC is to achieve environmental benefits and not health benefits. In the time available, it has not been possible to quantify the number of people that might be affected or the extent of the benefits.

However, if reductions in VOC content result in poorer performance, it may lead to an increase in the amount of time and physical effort the cleaners spend on any one window; or, alternatively, it could lead to a greater use of the low-VOC product, cancelling out any health benefits from a reduction in VOC content.

16.5. Environmental Impacts

16.5.1. Ozone reduction

The reduction of VOC emissions may reduce the ground level ozone concentration in Europe. The correlation between the VOC emission reduction and ozone concentration is a non-linear and is influenced by a number of parameters. In particular the NO_2 background concentrations and the meteorological conditions have a relevant impact on the ozone formation processes. The region or country where the VOC emissions are reduced have as well a relevant impact on the European wide changes in the ozone concentration due to different levels of ozone.

Table 142 shows the impacts of option 13 on the ground level ozone concentrations. For the calculations average meteorological conditions and the reference emission scenario for 2020 have been assumed. The impacts of the option have been assessed for the years 2015 and 2020.

Table 142: Impact of option 13 on the average ground level ozone concentration within EU-27 + Croatia and Turkey.

	average O3 concentration [ppb]	
	changes in [ppb]	percental changes
Scenario a) 2015	< 0.001	0.001%
2020	< 0.001	0.001%
Scenario b) 2015	0.001	0.002%
2020	0.001	0.002%

The ozone reduction may also contribute to prevent part of the production losses due to crop damage. The benefits of the VOC reduction due to the new regulation as proposed by option 13 have been quantified for scenario a) to be €267,268 in 2015 and €271,032 in 2020. For scenario b) the estimates result in €568,957 for 2015 and €576,969 in 2020.

16.5.2. Other environmental impacts

A.I.S.E. highlighted that products with a 3 % VOC limit will not have the same level of performance as is achieved by products with higher VOC content. A.I.S.E. guesses that the 3 % VOC limit may introduce the risk that consumers overdose the use of products in order to obtain the same cleaning performance. As a result there would be a reversion of the expected VOC reduction and greater discharges to water through the sewage system.

A.I.S.E. points to the use of additional surfactants as an alternative in order to achieve the same performance with the same quantities. This would result in higher amounts of surfactants ending up in waste water having the potential of adverse environmental impacts due to their inhibition of aeration in water. The extent is unknown to which this substitution will be realised by producers at either the 5 % or the 3 % VOC limit and is mentioned here as a possibility.

The consultants acknowledge that additional quantities may be used in case of difficult contaminations to be cleaned. As this is generally not the case in most household applications of glass cleaners, the described reverse effects are regarded as minor in comparison with the expected overall VOC reduction.

Consumers may also use additional quantities and opt for products formulated with more surfactants in order to achieve high performance. This would enhence the negative environmental effects. However, the effect is regarded as minor as additional surfactants would increase performance, and environmental impacts on water will be low as highly biodegradable surfactants are widely used and efficient waste waters treatment systems are generally installed.

No impacts from the options are expected regarding energy consumption.

16.6. Summary Impact Assessment

Table 143 summarises the different impacts that are likely to arise from implementation of the option to include household glass and window cleaning products within the scope of Directive 2004/42/EC. The ratings are based on the information set out in the preceding chapters.

Table 143: Summary Impact Assessment for option "Household, glas and window cleaners"

Impact/Stakeholder	Manufacturers	Professional Users	Consumers	Member State Authorities
Economic				
Capital/investment costs	-/?	0	0	n/a
Operating costs	0	0	n/a	-/?
Product and raw material prices	0	0	0	n/a
Imports/competitiveness	0	n/a	n/a	n/a
Competition	- (for SMEs)	0	n/a	n/a
Entry costs	-/?	0	n/a	n/a
Innovation/research	-/?	0	n/a	n/a
Product performance	n/a	-/? or 0	-/? or 0	n/a
Monitoring/Surveillance costs	-	n/a	n/a	-/?
Social				
Employment	-/? or 0	0	n/a	n/a
Health				
Environmental				
Cross media	-/?			
Waste and recycling	0			
Fuel consumption vehicle emissions	0			
Use of renewable/non-renewable resources	Unknown			
Key: 0 = no impact +/- = uncertain impact positive or negative -/? = likely slightly negative impact but unquantifiable due to lack of data + = Positive impact ++ = Strongly positive impact - = Negative impact -- = Strongly negative impact				

Annex 17

17. Road markings – Technical background information, VOC reduction potential (Option 16)

17.1. Road marking characteristics and application criteria

Road markings are produced to meet different requirements. One of the requirements is the wear of the markings due to roll over of cars and breaking behaviour or other mechanical stress. Another requirement is the reflective abilities in the dark and at rainy weather.

In Germany for example, about 70% of the road markings have to correspond to the requirements of the so called “Type II” road markings (special reflective abilities in the dark and at rainy weather). [BASt, 2009]

For some road markings systems, environmental conditions as well play a role for the applicability.

Therefore, there are some general criteria which have to be taken into account for the applicability of road markings systems:

- Frequency of roll over by cars
- Climate (fog, dew and humidity)
- Drying time under real terms
- Speed of application
- Permanence at mechanical stress (braking and starting behaviour of cars in that area, scrabbing of snowploughs, etc)
- Kind and age of surface to be marked (asphalt or concrete, contamination, adhesion, etc)
- Safety to traffic (elevation of the markings)
- Kind of use (origin road marking or reconditioning)

17.2. Coating systems, applications and VOC emissions

For road marking the four different coating systems are used, showing different characteristics of VOC emissions according to the coating system used and (in case of foil system) depending on the application technique.

Table 144: Solvent content and related VOC emissions of road marking systems

Paint Systems		Cold plastic Systems	Thermoplastic Systems	Foil Systems
solvent-based	water-based			
medium to high solvent content	low solvent content	medium solvent content (reacting during polymerisation)	no solvent content	in foils: no solvent content. Solvents contained in primers.
medium to high VOC emission	low VOC emission	low VOC emissions	no VOC emission	VOC emission if applied with primers

17.2.1. Paint systems

Paint systems can be solvent-based or water-based dispersion systems. The solvent content in the solvent-based systems differ from member state to member state, mainly depending on national regulations setting maximum VOC limit values for public tenders.

For solvent-based paints, usually high-solid systems are applied; e.g. in Germany and Switzerland the VOC content of solvent-based paint products can be estimated around 25w-%. [Plastiroute, 2009]

For water-based paints, the solvent content on product data sheets and other product information is stated with about 2w-% to 7w-%. [Comparision of product data sheets]

17.2.2. Cold plastic systems

Cold plastic road marking systems are monomer systems using solvents for reaction during application. The amount of evaporating not reacting solvents is estimated with usually < 1%. [Veluvine, 2009]

The average solvent content in cold plastics approved for the public tenders in Germany[97] is around 15-20w-%, with exceptions containing around 40w-%. The higher content is mostly found at cold spray plastic systems, which is due to the spraying application technique, requiring material of lower viscosity. [BASt, 2009]

17.2.3. Thermoplastic systems

Thermoplastic road marking systems are solvent free road marking systems.

Thermoplastics consist of a powder which is heated until it is liquid before application on roads. Application can be done via a screed-box or via spraying.

17.2.4. Foil systems

Foil road marking systems are normally used for temporary adoption [BASt, 2009]. Some manufacturers (e.g. 3M, Snoline) offer foils as well as long lasting road marking systems [3M, 2009]. The foil material itself is VOC-free. However, when applied to the road surface, additives have to be used which contain VOC.

The following foil systems of different durability are offered:

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[97] Approval is done by BASt (Bundesanstalt für Straßenwesen)

Foils for *temporary use* are bonded to the road after application of primers with adhesive function. Solvent content of primers can vary from 50% to near 100% according to safety data sheets of commonly used primer brands [e.g. Veluvine, 3M]. The average solvent content of primers is estimated with about 80% [Veluvine, 2009] [3M, 2009].

Foils for *durable use* are only offered by few companies [e.g. 3M, Snoline]. Producers underline that durable foils fulfil requirements of non-reflecting as well as for reflecting road markings. In Germany, for durable foils a guarantied durability of 4 years is required, whereas cold plastics have to last 2 years under guaranty [3M, 2009].

The following application techniques exist:

The foil can be fixed on hot asphalt during the last rolling operation. This technique does not use additives and therefore no VOC emissions occur. [3M, 2009]

The more commonly used technique uses a hot bitumen layer to fix the foil on the road. The bitumen is solvent free. [DGA, 2009-1] In case of *asphalt* surfaces, only bitumen is used to fix the foil on the road surface. [3M, 2009]

In case of *concrete* roads, the surface has to be pre-treated with a primer before the hot bitumen layer and the foil are applied [3M, 2009]. The primer contains about 35 – 45 % VOC (380 g/l) [DGA, 2009].

Application of foils for durable use is cost-intensive compared to other road marking systems. [3M, 2009]

17.3. Typical systems for original, repair and temporary coating

17.3.1. Original road marking

In Europe, commonly used systems for road marking vary significantly.

In Sweden most of the original road marking is done with **thermoplastic,** and the remaining proportion is usually done with **dispersion paints**. [Sweden, 2009]

In Germany, for original road marking, normally used systems are **cold plastics** or **thermoplastics**, especially on federal roads. This is due to the durability and criteria like use of reflecting material in the road marking system. In special cases, paint systems are used. This might be the case on streets with high mechanical stress like from snow ploughs. [BASt, 2009] [Sikkens, 2009]

First evaluations show, that at community level in Germany, for original road marking **paints** seem to be more frequently used than on federal roads. This may be due to the costs, but as well due to practicability. Traffic is often not that frequent, so that the markings last longer and working-sites are not under such time pressure. On the other hand, in built-up areas other criteria play a roll, like abrasion due to brake and start behaviour. [BASt, 2009] [Regierungsbezirk Karlsruhe, 2009]

17.3.2. Repair and reconditioning of road marking

Over time, road markings have to be re-coloured because they have become dirty or dark or parts have broken loose. For reconditioning, demarking of "old" markings and subsequent new application would be far too expensive. [DSGS, 2009]

Reconditioning can be done with re-painting on top of the existing systems. Painting over is typical e.g. in the Netherlands, Germany and Sweden. In Germany, about 85% of paint road marking systems are used for re-painting. [DSGS, 2009]

Broken down road markings can also be repaired with thermoplastics or cold plastics, but this may lead to undesired elevations of the markings, which needs consideration traffic safety. [DSGS, 2009] [Sikkens, 2009]

17.3.3. Temporary road marking

For the temporary road marking, normally foils are used, even if relative expensive and working-intensive. Other road marking systems (like paint systems) are used in special circumstances, e.g. when the road surface is old and will anyhow be replaced in the near future (when appearance is not that important anymore). [Regierungsbezirk Karlsruhe, 2009]

17.4. VOC emissions of solvent-based paint systems

According to statistics of Dow Chemical, in 2002 about 90,000 tons of road marking paints were applied in EU15 (except Ireland), whereof 80% was solvent-based (about 72,000 tons, seeTable 145). Assuming an average solvent content of 25%, solvent-based systems lead to 18,000 tons of VOC emission.

Table 145: Road marking sales [tons/year] in 2002 in EU 15 (except Ireland)

Countries	Solvent based paints	Water based paints	Thermo-plastics	Cold plastics	Total
Austria	3'500	700	1'000	500	**5'700**
Belgium	5'000	150	1'200	500	**6'850**
Denmark	400	200	6'200	100	**6'900**
Finland	300	2'000	4'000	100	**6'400**
France	18'000	4'000	8'000	3'000	**33'000**
Germany	14'000	2'800	12'000	8'000	**36'800**
Holland	4'000	200	6'000	500	**10'700**
Italy/Greece	19'000	1'000	5'000	1'000	**26'000**
Luxembourg	600	-	-	100	**700**
Spain/Portugal	7'600	2'400	6'000	1'000	**17'000**
Sweden	70	900	12'000	300	**13'270**
UK	500	100	35'000	1'000	**36'600**
Total	**72'970**	**14'450**	**96'400**	**16'100**	**199'920**

[Position Paper Manufacturers, 2009]

17.5. VOC emissions of foil road marking systems

17.5.1. VOC emissions of temporary foil road marking systems

The calculation of VOC emission from foil road marking systems is based on data of Germany because other data was not available.

In Germany, about 800,000 m^2 to 1,000,000 m^2 of temporary foils are applied on roads. [3M, 2009] About 200 g of primer is needed per square meter of foil to be applied, respectively about 250 ml/m^2. [Veluvine, 2009] [Brite-Line, 2009] [3M, 2009]

Assuming that 800,000 – 1,000,000 m^2 foil is used and fixed with 200g/m^2 of primer, the annual primer consumption in Germany is about 160 – 200 tons. Based on an average solvent content of 80%, **144 – 160 t of solvent** is used and emitted per year.

The use of foil systems for temporary road marking differs from country to country. Some countries, like e.g. Sweden, Finland or Italy do hardly use foil for temporary road marking at all. An extrapolation of the VOC emission figures of Germany is therewith not possible.

17.5.2. VOC emissions of durable foil road marking systems

In Germany applied about 150,000 m^2 to 200,000 m^2 of foil is used on roads for durable application. [3M, 2009]

About one third of this amount is applied directly on hot asphalt during the last rolling operation, not causing VOC emissions from road marking [3M, 2009].

Another third of the total amount is applied on asphalt surfaces using VOC-free bitumen for fixing, not causing VOC emissions from road marking. [3M, 2009].

The last third of the total amount is applied on concrete surfaces, needing an additional pre-treatment of the surface with a primer, related with VOC emissions. [3M, 2009]. Assuming that 50,000 – 67,000 m^2 of foil is used applying 0.4 l/m^2 of primer, the total primer consumption is 20 - 27 tons per year in Germany. With a VOC content of around 40% (380g/l) in primers, **16** to **21 t** of **solvent** is used annually.

The use of foil for durable road marking highly depends on the country. It is not known, that other European countries use durable foil as road marking system. An extrapolation of the figures of the Germany is therewith not possible.

Table 146: VOC emission from foil application in Germany

Annual data	Temporary application		Durable application			
Use of foils in Germany	800,000 m^2	1,000,000 m^2	50,000 m^2		67,000 m^2	
Specific use of primer	200 g/m^2 (250 ml/m^2)	200 g/m^2 (250 ml/m^2)	0.3 l/m^2	0.5 l/m^2	0.3 l/m^2	0.5 l/m^2
Total use of primer	160 t	200 t	15 t	25 t	20.1 t	33.5 t
VOC solvent content of primer	about 80%	about 80%	about 40%	about 40%	about 40%	about 40%
Total VOC emission	128 t	160 t	8 t	10 t	8 t	13 t
Estimated average VOC emission	144 t		11 t			

Calculation bases on information of [3M, 2009] [DGA, 2009]

17.6. VOC limits for road marking systems

17.6.1. Units used for definition of VOC limits

In several countries, VOC limits for road marking systems have been defined, using w-% units (weight-weight-%).[98] VOC limits of Directive 2004/42/EC are defined in g/l (weight-volume-%) and therefore are not directly comparable. The comparability has to be established by conversion:

A comparison of safety data sheets shows, that high-solid solvent-based paint systems have a density of about 1,5 g/cm^3, reactive 2-pack systems have about

[98] According to manufacturers, the definition in w-% was chosen due to its better practicability [Veluvine, 2009].

2,3 g/cm^3. [IVAM, 2009] The high density is due to the fact that filling agents are used for reflection, such as glass pearls.

This implies that a 25w-% VOC limit equals a VOC limit of 375 - 575 g/l. 10w-% VOC limit would equal about 150 - 230 g/l. [IVAM, 2009]

17.6.1.1. Existing national VOC limits for road marking systems

In several European countries restrictions for VOC solvent content in paint road marking systems are implemented, which are brought to bear on public tenders.

In **Germany**, for public tenders the solvent content of **paint** road marking systems (i.e. solvent-based or water-based) must not exceed **25w-%** ("minimum 75w-% solid content"). [ZTV M 02].

Austria as well restricts the solvent content of solvent-based paints in public tenders to **25w-%** ("≥ 75w-% solid content"). [ÖNORM B 2440]

In the **Netherlands**, a regulation for public tenders will come into effect soon, limiting the VOC-content to **28w-%**. [BRL 9141/03] [Veluvine, 2009]

In **Sweden**, since 1986 the solvent content of road marking systems is restricted in public tenders to **2w-%** by the Swedish Road Marking Administration (Vägverket), which practically means a ban of solvent-based paint systems. [ATB Väg 2005]

Also in **Finland** a factual ban of solvent-based paint road marking systems is in force since 2007 by enforcement of a VOC limit of **2w-%**. [Policies for Road Markings, year 2006]

VOC limits for paint road marking system can also be found in non-European countries. The Environment Protection Agency in the **USA** set a VOC limit of 100 g/l in 1998, equivalent to about **5w-%**. In **Canada** a restriction to **5w-%** was implemented in 2005. [Position Paper Manufacturers, 2009]

17.7. Substitution of VOC relevant road marking systems

17.7.1. Substitution of paint road marking systems for repair coating

Paint road marking systems based on solvents cause relevant VOC emissions.

Solvent based paint systems may be substituted by water-based paint systems (2% - 7% VOC) or by systems that produce no VOC emission (thermoplastics) or low VOC emission (cold plastics, foils not using primers).

Paint systems are often used to repair existing road markings, formerly made of cold plastics or thermoplastics. Re-colouring with the same VOC-free or low

VOC systems may not be wanted to avoid increased elevation. De-marking is generally too cost intensive. Water-based paint systems may be an alternative.

If the total amount of solvent-based paints would be substituted by water-based paints, the solvent consumption of 18,000 t would be reduced to 1,400 - 3,600 t. This would lead to a VOC emission reduction of 14.4 to 16.6 tons (-86%).[99]

During the consultation it was argued by some manufacturers and authorities that bonding of paints would need solvents to etch the former marking and to deal with soiled and oily surfaces. This would be difficult with water-based dispersions, which have low solvent content. For the re-paint of thermoplastic marking systems, dispersions can not be used because sufficient bonding cannot be achieved.

Other producers have argued, that the etching effect of solvents is not necessary, stressing that the argument is technically outdated. Depending on the formula of the water-based paints, dispersions as well adhere on dirty surfaces and are well able to be used for re-painting. Dispersions would even be used to act as adhesion promoting primers. [Position Paper Manufacturers, 2009] [Cleanosol, 2009]

17.7.2. Substitution of solvent-based paint road marking systems for original coating

Paint road marking systems are also used for **original road marking**. This is commonly the case e.g. in Sweden and in Finland, whereas it is less common in e.g. the Netherlands or Germany.

Original coating with solvent-based paints can be substituted with water-based paints or with thermoplastic or cold plastic systems.

The consultation revealed that in Sweden, Norway, Finland, Island and in all different climatic zones in the USA, water-based paint systems are commonly used for original road marking, bring up good results. This means that water-based paint systems are used under cold and humid weather conditions as well as in warm or hot climate. The lowest temperature recommend for the application of water-based paints is about 5°C (solvent-based paints are usually not applied at temperatures < 5°C as well). The wash-out time of the water-based systems would not be significantly higher than the wash-out time of solvent-based paints, depending on the formula and the handling of the water-based systems. [Position Paper Manufacturers, 2009] [Cleanosol, 2009]

In other countries (e.g. Germany or the Netherlands), mainly solvent-based paint systems are used for original road marking. For the preferred use of sol-

[99] According to producers of water-based coatings, the assumption of an average solvent content of 25% for solvent-based systems is regarded as a conservative approach. The VOC emission reduction potential is estimated with 20 kt [Dow Chemical, 2009].

vent-based paints the following arguments have been mentioned: Compared to solvent-based paints, the drying time of water-based paints is slower, depending on weather and climate conditions like low temperatures and humidity. At high traffic flows, the road markings would have to dry faster than dispersions could under those climatic conditions. Furthermore, the wash-out time of dispersions would be significantly longer than for solvent paints (wash-out in case of rain beginning after the application). One manufacturer stated that due to climatic influences, no good experiences would have been made with dispersions in Europe (except in southern European countries). Further more it was argued by manufacturers and authorities, that water-based paints would not be user friendly and handling would be difficult (which was explained by the little experience with this technology in countries usually using solvent-based paints).

Annex 18

18. Methodology for the quantitative Impact Assessment and the EcoSense-Model

18.1. Introduction

The cost-benefit analysis was performed by USTUTT-IER by applying the methodology of the CAFE[100] program. For the calculations the latest version of the EcoSense[101] model – EcoSenseWeb - together with the CAFE approach for the quantification of impacts and the valuation of the calculated endpoints has been used. The underlying methodology used in the analysis of benefits from reduced emissions is the impact pathway approach shown in the first chapter below. In chapter 18.5 a description of the applied version of the EcoSense model can be found where also a description of the parameterized version of the Eulerian EMEP dispersion model [Tarrasón, 2009] is provided. This dispersion model is integrated into EcoSenseWeb to quantify changes in ground level ozone concentrations due to emission reductions of VOC.

Concentration-response functions as published in the CAFE report have been applied to quantify the impacts. Mortality has been expressed by life years lost. To value a life year lost the median valuation of a VOLY[102] has been applied. Chapter 18.6 below provides a description of the quantification of the benefits of reduced air pollution including a description of the core set of concentration-response functions. For comparison the last updated concentration-response functions and monetary values of ExternE[103] as reported in the NEEDS[104] project are shown in annex chapter 18.6. Chapter 18.6.3 concludes with uncertainty considerations. [ExternE Update, 2005]

18.2. The Impact Pathway Approach

The underlying methodology used in the benefits analysis for quantification and monetisation of impacts in the study is the impact pathway approach (IPA) [ExternE Update], [CAFE, 2005 Volume 2]. The IPA is a bottom-up approach used to quantify environmental impacts along different pathways. The IPA starts with the emission of a pollutant at the location of the source into the environment; models its dispersion and chemical transformation in the different environmental media; identifies the exposure of the receptors and calculates the related impacts which then are aggregated to external costs. The principal steps can be grouped as follows:

- Emission: specification of relevant emissions and case scenarios, e.g. VOC reduction scenarios

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[100] CAFE: The Clean Air for Europe (CAFE) Programme: Towards a Thematic Strategy for Air Quality, COM (2001) 245, Communication from the Commission, Brussels, 04.05.2001

[101] The EcoSense model is an integrated atmospheric dispersion and exposure assessment model with implements the impact pathway approach developed within ExternE.

[102] VOLY: Value of a life year.

[103] ExternE: Externalities of Energy. Research project series of the European Commission. http://www.externe.info/

[104] NEEDS project: New Energy Externalities Development for Sustainability; http://www.needs-project.org/

- Dispersion: calculation of increased pollutant concentrations in all affected regions, e.g. changes in concentration of ozone, using models of atmospheric dispersion and chemistry for ozone (O3);
- Impact: calculation of the cumulated exposure from the increased concentration, followed by calculation of impacts (damage in physical units) from this exposure using an exposure-response function, e.g. cases of asthma due to the increase in O3;
- Cost: valuation of these impacts in monetary terms, e.g. multiplication by the monetary value of a case of asthma.

The impact pathway approach is shown in Figure 14: Impact Pathway Approach below.

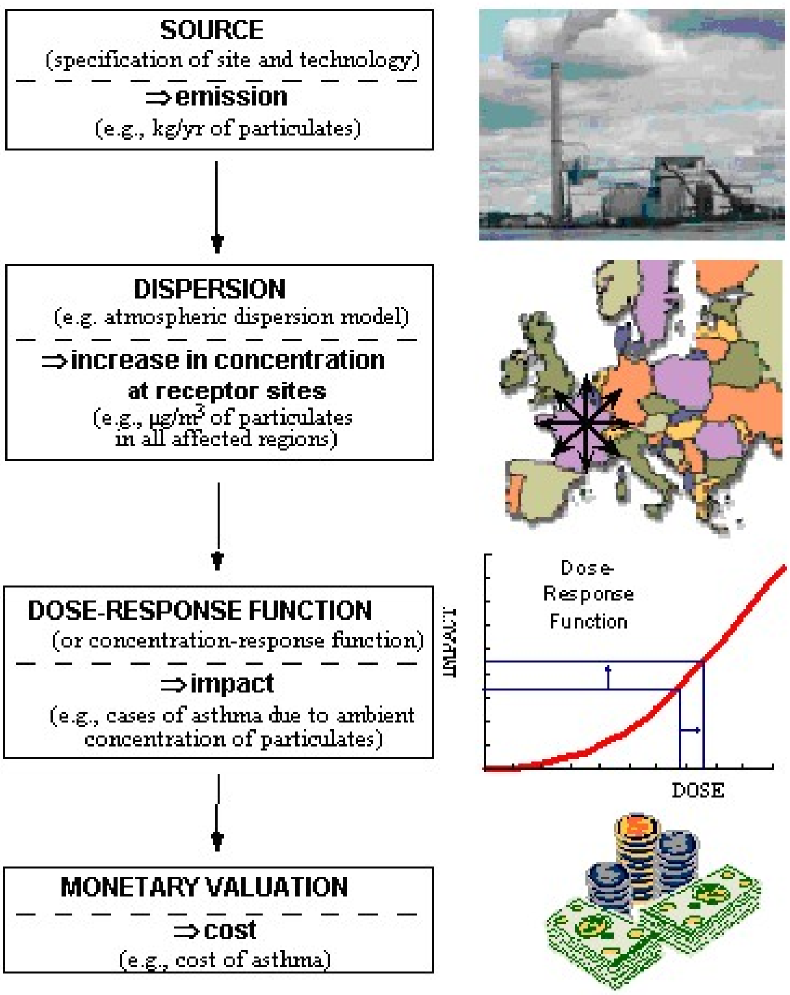

Figure 14: Impact Pathway Approach

18.3. Introduction

The cost-benefit analysis was performed by USTUTT-IER by applying the methodology of the CAFE[105] program. For the calculations the latest version of the EcoSense[106] model – EcoSenseWeb - together with the CAFE approach for the quantification of impacts and the valuation of the calculated endpoints has been used. The underlying methodology used in the analysis of benefits from reduced emissions is the impact pathway approach shown in the first chapter below. In chapter 18.5 a description of the applied version of the EcoSense model can be found where also a description of the parameterized version of the Eulerian EMEP dispersion model [Tarrasón, 2009] is provided. This dispersion model is integrated into EcoSenseWeb to quantify changes in ground level ozone concentrations due to emission reductions of VOC.

Concentration-response functions as published in the CAFE report have been applied to quantify the impacts. Mortality has been expressed by life years lost. To value a life year lost the median valuation of a VOLY[107] has been applied. Chapter 18.4 provides a description of the quantification of the benefits of reduced air pollution including a description of the core set of concentration-response functions. For comparison beside the concentration-response functions used within CAFE the last updated functions and monetary values of ExternE[108] as reported in the NEEDS[109] project are shown. Chapter 18.6.3 concludes with uncertainty considerations.

18.4. The Impact Pathway Approach

The underlying methodology used in the benefits analysis for quantification and monetisation of impacts in the study is the impact pathway approach (IPA) [ExternE, Methodology 2005 Update], [CAFE, 2005 Volume 2]. The IPA is a bottom-up approach used to quantify environmental impacts along different pathways. The IPA starts with the emission of a pollutant at the location of the source into the environment; models its dispersion and chemical transformation in the different environmental media; identifies the exposure of the receptors and calculates the related impacts which then are aggregated to external costs.

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105 CAFE: The Clean Air for Europe (CAFE) Programme: Towards a Thematic Strategy for Air Quality, COM (2001) 245, Communication from the Commission, Brussels, 04.05.2001

106 The EcoSense model is an integrated atmospheric dispersion and exposure assessment model with implements the impact pathway approach developed within ExternE.

107 VOLY: Value of a life year.

108 ExternE: Externalities of Energy. Research project series of the European Commission. http://www.externe.info/

109 NEEDS project: New Energy Externalities Development for Sustainability; http://www.needs-project.org/

The principal steps can be grouped as follows:

- Emission: specification of relevant emissions and case scenarios, e.g. VOC reduction scenarios
- Dispersion: calculation of increased pollutant concentrations in all affected regions, e.g. changes in concentration of ozone, using models of atmospheric dispersion and chemistry for ozone (O3);
- Impact: calculation of the cumulated exposure from the increased concentration, followed by calculation of impacts (damage in physical units) from this exposure using an exposure-response function, e.g. cases of asthma due to the increase in O3;
- Cost: valuation of these impacts in monetary terms, e.g. multiplication by the monetary value of a case of asthma.

The impact pathway approach is shown in Figure 14: Impact Pathway Approach below.

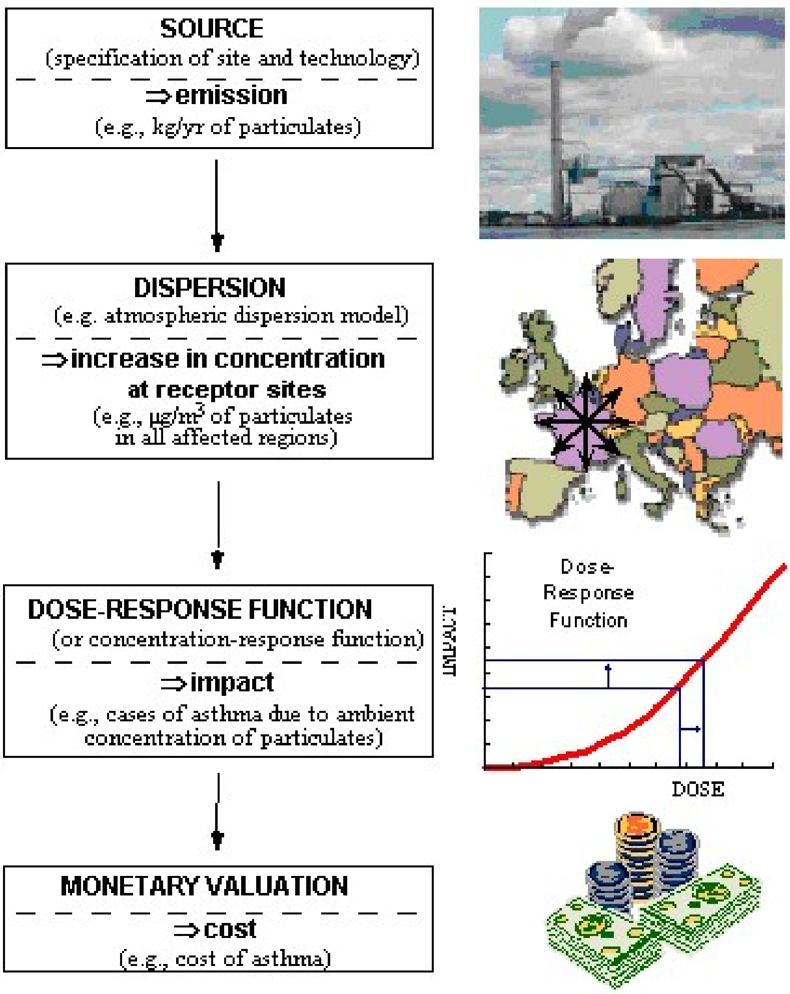

Figure 15: Impact Pathway Approach

18.5. The EcoSense Model

18.5.1. Overview

The impact assessment of emissions of NMVOC[110] and the calculation of the external cost has been performed with the aid of the software tool EcoSenseWeb, the latest version of the EcoSense model. This tool incorporates all necessary steps of the impact pathway approach (IPA). Therefore, it starts with the emission of a pollutant at the locations of the sources into the environment. Then the dispersion and chemical transformation is modelled [Tarrasón, 2008] on a European scale with a resolution of approximately 50 km x 50 km. The calculations are based on a set of source-receptor relationships which are constructed using the EMEP chemical transport model. The EMEP model has been largely used in European policy applications and it supported the scenarios under the CAFE program. Within EcoSense the model supports the regional European wide modelling and it covers the spatial domain as shown in Figure 14. In particular for secondary pollutants (including Ozone) it is important to consider a large spatial domain in the calculations as the major part of impacts occur outside the local scale (local is defined as approximately around 50 km of the source). Based on receptor distribution (population, crops, materials, different land use types) the exposure of the receptors is calculated. The exposure to ozone is (non-exclusively) caused and influenced by emission of VOCs. The related impacts (e.g. health impacts like additional cases of chronic bronchitis) are derived by application of concentration response functions [CAFE, 2005 Volume 2] and alternatively, [Torfs et al 2007] i.e. impact per concentration increment. Since many different endpoints are quantified the results have to be aggregated. One recommended option for weighting and aggregation are external costs [Desaigues et al, 2007 and EcoSenseWeb User's Manual 2008] also applied in the CAFE-Cost Benefit Analysis.

18.5.2. Atmospheric dispersion modelling

To assess the changes of ozone concentration due to VOC reduction scenarios the regional damage assessment is based on the parameterised Eulerian EMEP dispersion model [Tarrasón, 2009]. The parameterised Eulerian EMEP model itself is constructed by a number of preceding computations of the Unified EMEP model where parameters sensitive for the result are independently modified to provide a simplified relation between the parameter and the result. Examples of parameters are emissions of pollutants or different meteorological conditions. Parameterised Eulerian dispersion models are important components of integrated assessment tools as they allow a simple relation between specific emission and impact and need much less resources to be run in comparison to the full EMEP model. Next a short description of the Unified EMEP model based on [Tarrasón, 2009] will be provided. Followed by a short explanation how the source-receptor-relationships have been computed and a description how these relationships are used within EcoSenseWeb to compute damages and externalities.

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[110] NMVOC: VOC emissions without the consideration of methane.

The unified EMEP model [Tarrasón, 2009]

The Unified EMEP model, developed at the Norwegian Meteorological Institute met.no[111], provides the physical information (i.e. concentrations and depositions of pollutants) to relate sources of air pollutants with their effects at receptor areas. The Unified Eulerian EMEP model is a multi-layer atmospheric dispersion model for simulating the long-range transport of air pollution and has been validated over several years. The air pollutants under consideration are those involved in ecosystem and health damages, in particular sulphur oxides, nitrogen oxides, ammonia, ground level ozone and atmospheric particles. The modelling is done on 20 vertical layers and generally on a 50*50km^2 EMEP polar stereographic grid [Simpson et al, 2003].

The model includes about 70 species and approx. 140 reactions. It uses the EMEP chemical scheme that has been extensively peer-reviewed [Hov et al., 1978; Simpson, 1992; Andersson-Sköld and Simpson, 1999]. Particulate matter is described in the model as fine particles (PM2.5, particles with dry aerosol diameters below 2,5µm) and coarse particles (PMcoarse, particles with dry aerosol diameters between 2,5µm and 10µm).

The model version used to calculate source-receptor relationships is rv2.6 [Fagerli et al., 2004] and thus it is the same as used in the policy applications under the CAFE Program. The parameterisation of the Eulerian EMEP dispersion model has been based on two different underlying emission scenarios, a reference scenario for 2010 and a reduced emission scenario for 2020[112]. The emission data set for 2010 corresponds to the base-line Current Legislation (CLE) scenario and the 2020 emission scenario is a scenario more demanding than the current legislation scenario (2020_CLE) but less than the maximum technically feasible reduction (2020_MFTR). Both scenarios were developed by IIASA for the development of the Thematic Strategy on Air and are documented in [Amann et al., 2007]. The emissions provided by IIASA include data for all EU countries. For countries other than EU countries, the scenario data is used according to [Cofala et al., 2006]. This study was part of the review process of the Convention on Long-range Transboundary Air Pollution (CLRTAP). It documents the current state of the database of the RAINS (Regional Air Pollution Information and Simulation) model with respect to non-EU countries and was supposed to serve as a base for the review of the data by national experts

The data provided by IIASA for the Thematic Strategy Scenarios are specified by country and activity sector. The activity sector data are organized according to CORINAIR SNAP 11 classification. These emissions are then spatially distributed by the Norwegian Meteorological Institute met.no according to a basic grid distribution as described in [Tarrasón et al., 2004]. In the study, Tarrasón et al. document the emission data used in source receptor and scenario calculations as they were carried out under the CAFE project. The methodology developed for the spatial distribution of the emissions followed an aggregated sector approach, meaning that emissions for all over Europe from the same sector were distributed according to the same principles. The main indicators for the distribution of the emissions are information on large point sources (for the identification of the

[111] The Norwegian Meteorological Institute, met.no; http://met.no

[112] The data are available from met.nos emission database upon request. The internal reference for these data created in the summer of 2006 is 2006_emis2010_BL-E_V7/ (base: BL_CLE_2010) and 2006_emis2010_BL-E_V7/ (base: BL_CLE_2010)

sources of emissions and the intensities of the sources), population numbers and distribution (to identify sources in the surroundings of urban centres).

Documentation on how the source-receptor relationships have been computed [Tarrasón, 2009 and EcoSenseWeb User's Manual 2008]

Source-receptor relationships are important components of integrated assessment tools as they allow a simple relation between specific emission and resulting changes in the environment (e.g. concentrations and depositions), leading to impacts at the receptor. The source-receptor (SR) calculations with the EMEP Unified model give the change in various pollutant indicators at each receptor grid area of 50x50 km^2 resulting from a change in anthropogenic emissions from each emitter country or sub-regions in Europe.

SR are generated for each country or sub-region by reducing emissions for each country of one or more precursors by 15%, then re-running the EMEP model, and comparing the resulting fields with the base-case or reference fields. The justification of the 15% reduction is that the reduction of individual emission is then small enough to approximate a mathematical derivative, but is sufficiently large to give a clear signal in the pollution changes.

To represent the impact of emissions from a specific country, or region, we need 4 separate runs of the EMEP model, one for each precursor pollutant: sulphur dioxide (SO2), nitrogen oxides (NOx), ammonia (NH3) and non methane volatile organic compounds (NMVOC). Fine-primary particulates (PPMfine) and coarse primary particulates (PPMcoarse) emissions are assumed inert and so have no effect on the chemistry associated with the remaining four gaseous precursors. Therefore, no separate runs are required for PM. The other pollutants show significant chemical interactions which must be accounted for, and therefore separate SR calculations are carried out. This method was used for all countries and sub-regions.

The method to derive SR calculations with the EMEP Unified model was derived from a sample of several hundred runs of the full EMEP Eulerian model with systematically perturbed emissions of the individual sources. The method is justified in detail in [Tarrasón et al., 2003] and [Wind et al.,2004].

In order to deal with meteorological variability, SR relationships were derived for two sets of crucial emission scenarios in 2010 and 2020 (above a description of the emission scenarios 2010 and 2020 is provided) for 5 different meteorological years. The selected five years were 1996, 1997, 1998, 2000 and 2003. The selection was the result of a careful meteorological and air quality evaluation of the representativeness of these years with respect to climatological studies [Tarrasón et al., 2005]. The average of the first four years is climatologically representative for the last 30 years. In the case of 2003, the year was selected with regard to feasible meteorological situations predicted for 2020-2030.

The use of source-receptor matrices within EcoSense

To get the changes of a policy scenario in the environment (e.g. concentrations and depositions) the source-receptor matrices can be used as following:

1. For a combination of country and reduced pollutant the corresponding source-receptor matrix has to be selected. The selected matrix contains the resulting air

quality of a preceding off-line run of the Unified EMEP model where the selected pollutant has been reduced by 15% compared to the reference emission scenario within the selected country or region.

2. Usually the analysed scenario does not exactly match the 15% reduction. Thus the result of the matrix has to be scaled to fit the scenario.

3. The first two steps have to be repeated for each combination of country and reduced pollutant. The particular results are summed to a full picture of the analysed emission scenario.

4. To minimize the impact of a specific meteorological condition the steps 1 to 3 are iterated for each considered meteorological year and averaged.

5. Doing integrated assessment usually we are interested in the changes of e.g. the air quality due to a policy scenario. Thus the resulting air quality after step 4 has to be compared with the corresponding air quality of the reference emission scenario.

6. The resulting changes in the environment are then used in EcoSense within succeeding modules. The results of the source-receptor calculations are input for the impact and monetary valuation modules. These steps are described in detail in the next chapter.

If the calculations are done for hundreds of artificial scenarios and repeated for a number of countries the damage increment per unit of emission for relevant countries can be calculated and aggregated in a table where damages are allocated to the different receiving countries. An example of such a recalculation is shown in annex 19 of this report.

18.5.3. Quantification of impacts and monetary valuation

The impacts (damages in physical units) by changes in the air quality are quantified by the use of concentration-response functions as reported in the CAFE report [CAFE, 2005 Volume 2] for human health and as reported in [ExternE, Methodology 2005 Update] for the impacts on crops (see Chapter 18.6.2). For human health the core functions as depicted in Table 148 have been used.

The valuation of mortality impacts is based on median values of a life year, i.e. € 52,000 per year (taken form CAFE-CBA). An overview of all health valuation data for the monetisation is provided in chapter 18.6.

18.5.4. The geographical scope and geographical resolution of the model

The geographical scope of a model expresses the area where the air quality can be modelled, receptor data exists and all other information like meteorological data and topography is included in the model. EcoSenseWeb follows the concept of a nested approach where models for different spatial resolutions are combined. Sensitive areas or areas close to sources are explored in more detail with local scale models. Calculations are performed on three different spatial resolutions:

- on the local scale; close to emission sources (with a geographical scope of 100 km x 100 km and a resolution of 10 km x 10 km);
- on a European scale specified by the EMEP-grid[113] with definition of 1997;
- and on a north hemispheric scale.

A detailed description of the modelling approaches on the different scales is found in the user manual [EcoSenseWeb User's Manual 2008] of EcoSenseWeb.

For the impact assessment due to the changes in VOC emissions and related changes in ozone concentrations the European scale is most relevant. Thus, the calculations accomplished within this study were carried out on the EMEP-grid which facilitates the comparison of these results with results from previous studies or results from CAFE-CBA.

The EMEP-grid with definition of 1997 covers main parts of Europe with a spatial resolution of 50 km x 50 km. Figure 16 shows the coverage of the EMEP grid. All the calculations of impacts in this report were done on this spatial domain and resolution. Shown figures of externalities are obtained by an aggregation of results over all individual cells of the EMEP-grid.

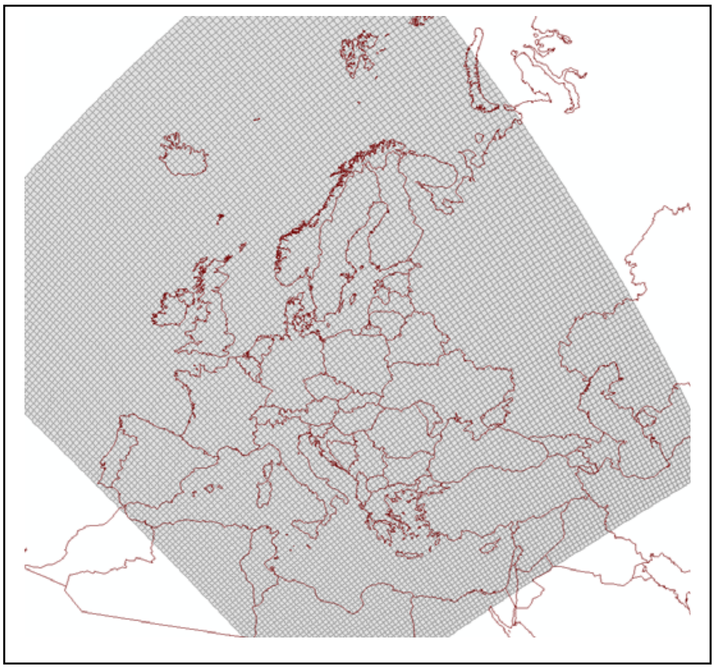


Figure 16: The EMEP-grid

[113] The EMEP grid has been defined within the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP). http://www.emep.int/grid/index.html

18.6. Quantification of the benefits of reduced air pollution

18.6.1. Impacts to human health

A consensus has been emerging among public health experts that air pollution, even at current ambient levels, aggravates morbidity and leads to premature mortality. From epidemiological studies within the Clean Air for Europe (CAFE) programme a set of concentration-response functions (CRFs) to quantify health impacts from ambient air pollution in Europe has been provided [CAFE, 2005 Volume 2]. An overview of the concentration-response functions is shown in Table 147 and Table 148. Within the EC project NEEDS the set of concentration-response functions and the monetisation of the health endpoints has been revised [Torfs et al 2007]. An overview of these values is shown in Table 149.

Within this study the impacts of changes in the ozone concentration are quantified by the core set of concentration-response functions as proposed in CAFE (Table 147 and Table 148). The core recommendations for mortality related to PM and ozone are based on recommendations of WHO-CLRTAP Task Force on Health (TFH). Core functions are those for which evidence is best, sensitivity functions are those for which there is good evidence for effect, but a weakness at some point in the impact pathway.

The core set related to ozone consists of:

- Acute mortality from ozone
- Respiratory hospital admissions (for the age group over 65)
- Minor restricted activity days (age group from 18 to 64)
- And respiratory medical use by adults.

The acute mortality is quantified by years of life lost (YOLL) and valued by a value for a life year lost (VOLY). The value used in this report for a life year lost is the median valuation, i.e. € 52,000 per year.

Comparing the set of concentration response function and the values for valuation used within CAFE and NEEDS shows only minimal differences. The different numbers do not impact the main results of the report. This is not surprising as CAFE and NEEDS use similar approaches and are widely based on similar studies. There are some differences in the selected and suggested concentration-response functions, differences in the assumptions for monetisation and within NEEDS some monetary values are recently revised. A comparison of results calculated with CAFE assumptions and with NEEDS assumptions is shown in annex 19.

Beside the robust and widely accepted pathway to quantify the impacts of VOC emissions by quantifying changes in ozone concentrations and applying concentration-response functions there is some evidence that some VOC compounds might have direct health impacts, i.e. might cause cancer (e.g. [Sax, S. N., et al. 2006] and [Loh, M. M. et al., 2007]). Those effects are not considered in this report as carcinogenic VOC's are not used anymore in paints or other consumer products and thus those effects are not very relevant within this report. Beside this, the direct health impacts are linked with high uncertainty.

Table 147: Overview of the concentration response functions for PM and corresponding monetary values used in CAFE

Effect	Pollutant factor 1	Pollutant factor 2	Population factor 1	Population factor 2	Incidence rate	Response functions	Valuation
CORE FUNCTIONS							
Chronic mortality (deaths, VSL valuation)	1	0.1	0.628	1	1.61%	6.00%	€ 2,000,000
Chronic mortality (life years lost, VOLY valuation)	1	1	1	1.00E-05	1	65.1	€ 52,000
Infant mortality (1 – 11 months)	1.54	0.1	0.009	1	0.19%	4.00%	€ 1,500,000
Chronic bronchitis, population aged over 27 years	1.54	0.1	0.7	1	0.378%	7.00%	€ 190,000
Respiratory hospital admissions, all ages	1.54	0.1	1	1.00E-05	617	1.14%	€ 2,000
Cardiac hospital admissions, all ages	1.54	0.1	1	1.00E-05	723	0.60%	€ 2,000
Restricted activity days (RADs) working age population	1	1	0.672	1	19	0.475%	€ 82
Respiratory medication use by adults	1.54	0.1	0.817	0.001	4.50%	908	€ 1
Respiratory medication use by children	1.54	0.1	0.112	0.001	20%	180	€ 1
Lower respiratory syndromes (LRS), including cough, among adults with chronic symptoms	1.54	0.1	0.817	1	0.3	1.30	€ 38
LRS (including cough) among children	1.54	0.1	0.112	1	1	1.85	€ 38
SENSITIVITY FUNCTIONS							
Consultations for asthma, ages 0-14	1.54	0.1	0.170	0.001	47.1	2.50%	€ 53
Consultations for asthma, ages 15-64	1.54	0.1	0.672	0.001	16.5	3.10%	€ 53
Consultations for asthma, ages over 65	1.54	0.1	0.158	0.001	15.1	6.30%	€ 53
Consultations for upper respiratory symptoms (excluding allergic rhinitis) ages 0-14	1.54	0.1	0.170	0.001	574	0.70%	€ 53
Consultations for upper respiratory symptoms (excluding allergic rhinitis) ages 15-64	1.54	0.1	0.672	0.001	180	1.80%	€ 53
Consultations for upper respiratory symptoms (excluding allergic rhinitis) ages over 65	1.54	0.1	0.158	0.001	141	3.30%	€ 53
Extra for RADs, total population	1	1	0.328	1	19	0.475%	€ 69

Table 148: Overview of the concentration response functions for ozone and corresponding monetary values used in CAFE

Effect	Pollutant factor 1	Pollutant factor 2	Population factor 1	Population factor 2	Incidence rate	ERF	Valuation
CORE FUNCTIONS							
Acute mortality (life years lost, VOLY median valuation)	0.0055	0.1	1	1	1.09%	0.30%	€ 52,000
Acute mortality (life years lost, VOLY mean valuation)	0.0055	0.1	1	1	1.09%	0.30%	€120,000
Respiratory hospital admissions, ages over 65	0.0055	0.1	1	1.00E-05	617	0.30%	€ 2,000
Minor restricted activity days, ages 18-64	0.0055	0.1	0.64	1	7.8	1.48%	€ 38
Respiratory medication use by adults	0.0055	0.1	0.817	0.001	4.50%	730	€ 1
SENSITIVITY FUNCTIONS							
Minor restricted activity days, ages over 65	0.0055	0.1	0.158	1	7.8	1.48%	€ 38
Respiratory symptoms among adults	0.0055	0.1	1	0.001	1	343	€ 38

Table 149: Overview of the concentration response functions for PM and ozone and corresponding monetary values used in NEEDS

Core Endpoints										
	Pollutant	Risk group (RG)	RGF value	Age Groupe (AG)	AGF value	CRF [1/(µg/m3)]	phys. Impact per person per µg per m3 [1/(µg/m3)]	unit	Monet Val per case or per YOLL [Euro]	External costs per person per µg per m3 [1/(µg/m3)]
primary and SIA < 2.5, i.e. Particle < 2.5µm										
Life expectancy reduction - YOLLchronic	PM2.5	all	1.000	Total	1	6.51E-04	6.51E-04	YOLL	40,000	2.60E+01
netto Restricted activity days (netRADs)	PM2.5	all	1.000	MIX	1	9.59E-03	9.59E-03	days	130	1.25E+00
Work loss days (WLD)	PM2.5	all	1.000	Adults_15_to_64_years	0.672	2.07E-02	1.39E-02	days	295	4.10E+00
Minor restricted activity days (MRAD)	PM2.5	all	1.000	Adults_18_to_64_years	0.64	5.77E-02	3.69E-02	days	38	1.40E+00
primary and SIA < 10, i.e. Particle < 10µm										
Increased mortality risk (infants)	PM10	infants	0.002	Total	0.009	4.00E-03	6.84E-08	cases	3,000,000	2.05E-01
New cases of chronic bronchitis	PM10	all	1.000	Adults_27andAbove	0.7	2.65E-05	1.86E-05	cases	200,000	3.71E+00
Respiratory hospital admissions	PM10	all	1.000	Total	1	7.03E-06	7.03E-06	cases	2,000	1.41E-02
Cardiac hospital admissions	PM10	all	1.000	Total	1	4.34E-06	4.34E-06	cases	2,000	8.68E-03
Medication use / bronchodilator use	PM10	Children meeting PEACE criteria - EU average	0.200	Children_5_to_14	0.112	1.80E-02	4.03E-04	cases	1	4.03E-04
Medication use / bronchodilator use	PM10	asthmatics	0.045	Adults_20andAbove	0.798	9.12E-02	3.27E-03	cases	1	3.27E-03
Lower respiratory symptoms (adult)	PM10	symptomatic_adults	0.300	Adults	0.83	1.30E-01	3.24E-02	days	38	1.23E+00
Lower respiratory symptoms (child)	PM10	all	1.000	Children_5_to_14_years	0.112	1.86E-01	2.08E-02	days	38	7.92E-01
Ozone [µg/m3] - from SOMO35 by multiplication by *1/365										
Increased mortality risk	SOMO35*1/365	Baseline_mortality	0.0099	Total (YOLL = 0.75a/case)	1	3.00E-04	2.23E-06	YOLL	60,000	1.34E-01
Respiratory hospital admissions	SOMO35*1/365	all	1.000	Elderly_65andAbove	0.158	1.25E-05	1.98E-06	cases	2,000	3.95E-03
MRAD	SOMO35*1/365	all	1.000	Adults_18_to_64_years	0.64	1.15E-02	7.36E-03	days	38	2.80E-01
Medication use / bronchodilator use	SOMO35*1/365	asthmatics	0.045	Adults_20andAbove	0.798	7.30E-02	2.62E-03	cases	1	2.62E-03
LRS excluding cough	SOMO35*1/365	all	1.000	Children_5_to_14_years	0.112	1.60E-02	1.79E-03	days	38	6.81E-02
Cough days	SOMO35*1/365	all	1.000	Children_5_to_14_years	0.112	9.30E-02	1.04E-02	days	38	3.96E-01

CRF: concentration-response function.

YOLL: years of life lost.

RAD: Restricted activity days.

WLD: Work loss days.

MRAD: Minor restricted activity days.

LRS: lower respiratory symptoms.

18.6.2. Impacts on crops

This section is taken from [ExternE, 1999, Vol. 7] and [ExternE, Methodology 2005 Update]. It draws on the latest methodological developments within the ExternE-Pol project and on earlier reports of the ExternE methodology.

Effects from Ozone

For the assessment of ozone impacts, a linear relation between yield loss and the AOT 40 value (Accumulated Ozone concentration above a Threshold of 40 ppbV) calculated for the growth period of crops (May to June) is assumed. The relative yield change is calculated using the following equation together with the sensitivity factors given in Table 150:

$$y = 99.7 - \alpha \cdot \mathrm{AOT40crops}$$

with y = relative yield change

α = sensitivity factors

Table 150: Sensitivity factors (α) for different crop species

Crop species	Sensitivity factor
Rice	0.4
Tobacco	0.5
Sugar Beet, potato	0.6
Sunflower	1.2
Wheat	1.7

18.6.3. Uncertainty

Sensitivity and uncertainty analysis has been carried out within the CAFE report Volume 3 [CAFE, 2005 Volume 3] as well as in ExternE [ExternE, Methodology, 2005 Update] and recently in the NEEDS [Spadaro and Rabl, 2007] project. A number of individual sources of uncertainty have been identified and within [ExternE, Methodology, 2005 Update] an attempt to group them into different categories has been taken:

i. data uncertainty, e.g. slope of a dose-response function, cost of a day of restricted activity, and deposition velocity of a pollutant;

ii. model uncertainty, e.g. assumptions about causal links between a pollutant and a health impact, assumptions about form of a dose-response function (e.g. with or without threshold), and choice of models for atmospheric dispersion and chemistry;

iii. uncertainty about policy and ethical choices e.g. discount rate for intergenerational costs, and value of statistical life;

iv. uncertainty about the future, e.g. the potential for reducing crop losses by the development of more resistant species;

v. idiosyncrasies of the analyst, e.g. interpretation of ambiguous or incomplete information.

The first two categories (data and model uncertainties) are of a scientific nature and are of main focus in this report. They are amenable to analysis by statistical methods, combining the component uncertainties over the steps of the impact pathway, in order to obtain formal confidence intervals around a mid estimate. For ethical choice and for uncertainty about the future a sensitivity analysis may be more appropriate, indicating how the results depend on these choices and on the scenarios for the future.

Some of the uncertainties are quantifiable by statistical methods but other sources of uncertainty can only be described qualitatively. In this chapter we start with a short analysis and qualitative assessment of sensitive assumptions and input data as well as with uncertainties related to the modelling approach. After that a statistical and an analytical approach are applied to quantify the uncertainties of the full methodology to assess environmental impacts.

Uncertainties related to basic assumptions and input data.

Some few basic assumptions with a relevant influence on the modelled changes of ground level ozone concentrations due to changes in VOC emissions are mentioned here:

- Different VOC compounds might have different so-called photochemical oxygen creation potential; this is not considered in this report due to lack of information. A typical scheme of VOC compounds has been assumed.
- The modelled ozone concentration is sensitive to the background emission of VOC and NOx. The modelled data is based on the reduced 2020 reference scenario [Tarrasón, L., 2009] related to developments by IIASA for the Thematic Strategy on Air [Amann et al., 2007]. This seems to be a realistic emission scenario for the close future.
- Meteorological conditions for the near future. The calculations in this report are based on average meteorological conditions. The EMEP model has been applied for four different meteorological years (1996, 1997, 1998, and 2000) and the results are averaged over these years to diminish the impact of the meteorological conditions on the results.

Uncertainties related to the Eulerian Unified EMEP model.

From the EMEP Status Report [EMEP Status Report, 2008] the main uncertainties related to the model are reviewed. Here some of them are mentioned:

- The coupling between the atmosphere and biosphere is increasingly recognised as being a crucial part of predicting future air pollution levels;

- Biogenic emissions of VOC or nitrogen compounds are still subject to very large uncertainties. BVOC emissions play a major role in ozone formation. Emissions of NO from soils will also contribute to ozone formation, and contribute to N- deposition.

- With respect to model physics, probably the biggest uncertainty is due to the suboptimal parameterisation of convective processes. At present these are included as diffusion only.

Beside these EMEP has an adequate protocol for dealing with the issue of model validation and quality control.

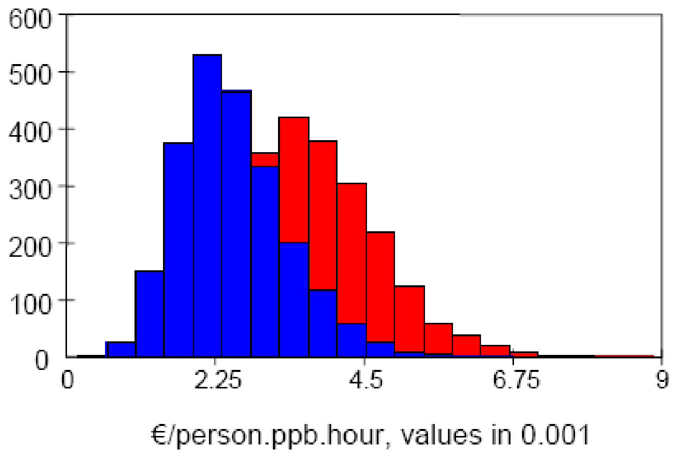
Within this report a parameterised version of the Unified EMEP model has been used for calculations. To get a parameterized version the results of full model runs for fictive scenarios, in which the emissions of e.g. VOC are reduced in a country by 15%, are stored. These results are then linearly extrapolated to the study scenario with an increase of uncertainty. The farther the studied emission reduction is from the 15% reduction the higher is the uncertainty due to this approach.

Uncertainties related to the analytical chain.

Within the CAFE report Volume 3 [CAFE, 2005 Volume 3] the uncertainties in the analytical chain have been analysed. There, first, the parameters have been identified which will give rise to the greatest level of uncertainty. Considering the chain of impact or benefit quantification following parameters can be identified:

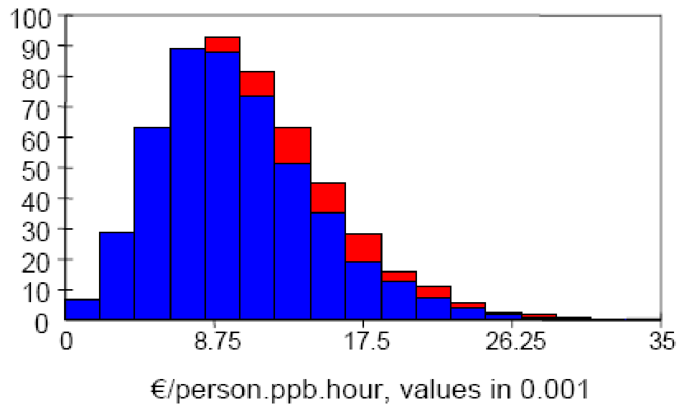
- Pollution concentration
- Population at risk
- Incidence rate (for deaths, respiratory hospital admissions, etc.)
- response functions, and
- valuation.

The first parameter, the pollution concentration, has already been considered qualitatively above. The second parameter, population at risk, is known with a reasonably high level of accuracy from standard national demographic statistics. There is some uncertainty from the need to forecast population in the future. Though as the analysis only goes out to 2020 this is unlikely to be of great importance. Uncertainty in the remaining three factors, incidence rate (particularly for morbidity), response functions, and valuations, have been assessed in the analysis of CAFE. Starting form the estimated uncertainties and the probability distributions of the input parameters, e.g. incidence data, exposure-response functions, valuation estimates for mortality, a Monte Carlo sampling for a total of 10,000 iterations has been conducted. The results are shown here including sensitivity considerations.



[CAFE, 2005 Volume 3]

Figure 17: Probability distribution for aggregate damage functions (combining mortality and various morbidity effects) for ozone assessments for health core functions only. Blue bars show estimates including the median value of the VOLY, red bars show estimates including the mean value.



[CAFE, 2005 Volume 3]

Figure 18: Probability distribution for aggregate damage functions (combining mortality and various morbidity effects) for ozone assessments for health core and sensitivity functions. Blue bars show estimates including the median value of the VOLY, red bars show estimates including the mean value.

The results show the distribution of the impacts and the related uncertainty with the calculation of health effects related to ozone. The aggregated damage functions (€/person*ppb*hour) are shown in the figures, i.e. the probabilised distribution of the product of incidence rate, response function and valuation data summed over the set of endpoints quantified for ozone. In Figure 18 the aggregated damage function takes into account only the core set of exposure-response functions where in Figure 17 additionally the functions identified for sensitivity analysis are included. The concentration response functions and the classification in core functions or sensitivity function are shown above in Table 147 of chapter 18.6.1.

The latter figures also show that the sensitivity functions add considerably to the damage factors for ozone (noting the change in scale on the x-axis). Different assumptions for valuation have also a considerable impact on the results.

Within our studies the median value of the VOLY has been used which corresponds to the blue bars in the figures.

For the calculations with median valuation of VOLY (blue bars in Figure 17) the mean is 0.0025 where the 2.5%-ile is 0.0012 and the 97.5%-ile is 0.0044.

Another attempt to quantify the uncertainties of environmental impacts and damage costs was undertaken within the NEEDS deliverable “Report on the methodology for the consideration of uncertainties“ [Spadaro and Rabl, 2007]. Within this NEEDS report the issue of uncertainty is discussed and guidance on how to deal with uncertainty is provided. This analysis is based on earlier work done within ExternE, cf. e.g. [ExternE, Methodology, 2005 Update]. In the following a short summary of the work done within the deliverable [Spadaro and Rabl, 2007] is shown and some results are given.

Whereas the uncertainty of environmental impacts and damage costs is usually estimated by means of a Monte Carlo calculation, the report [Spadaro and Rabl, 2007] shows that most (and in many cases all) of the uncertainty calculation involves products and/or sums of products and can be accomplished with an analytic solution which is simple and transparent. First the component uncertainties have been estimated and then the total uncertainty for the impacts and damage costs of the classical air pollutants has been calculated. The distribution of the damage costs is approximately lognormal and can be characterized in terms of geometric mean μg and geometric standard deviation σg, implying that the confidence interval is multiplicative. The authors than find that for the classical air pollutants σg is approximately 3 and the 68 % confidence interval is [μg / σg, μg x σg]. Because the lognormal distribution is highly skewed for large σg, the median is significantly smaller than the mean.

Thus, with 68 % confidence the environmental impacts and damage costs (or benefits) are within the interval of the best estimate of the costs divided by 3 and the best estimate of the costs multiplied by 3.

Annex 19

19. Reduced external costs per ktone of avoided VOC emissions

19.1. Methodology

The EcoSense [EcoSenseWeb User's Manual, 2008] model together with the parametrised Eulerian dispersion model [Tarrasón, 2008] has been used to parameterise the damage increment per unit of emission of one kilotonne of NMVOC per country.

Concentration response functions and monetarization of the Clean Air for Europe (CAFE) [CAFE, 2005 Volume 2] Programme as well as of the NEEDS project [Torfs R., Hurley F. and Miller B., 2007] have been used and compared.

The calculations have been repeated for two different underlying emission scenarios (i.e. 2010 and 2020 emission scenario). The figures are based on average meteorological conditions.

Beside abated external costs the impacts on mortality and morbitity are shown in the following tables.The figures are based on the reduced human ozone exposure due to reduced VOC emission.

Two sets of tables are shown: The VOC reduction within a country could have an impact all over Europe. Thus 'EMEP-receptor-grid' means that the full spatial area of the model is taken into account for exposure assessment. It might be also of interest to only account for the impacts within EU-27 plus Croatia and Turkey. The tables with those results are marked with 'EU-27+2-receptor-grid'.

19.2. Results

Table 151 Country specific human health benefits per ktone of avoided VOC emission. Average meteorological conditions, 2010 emission scenario and EMEP-receptor-grid.

	External Costs NEEDS	**External Costs CAFE**	**Mortality NEEDS**	**Mortality CAFE**	**Morbidity NEEDS**			**Morbidity CAFE**		
Country			YOLL NEEDS	YOLL CAFE	RHA - Respiratory hospital admissions, ages over 65	MRAD - Minor restricted activity days, ages 18-64	RMU - Respiratory medication use by adults	RHA - Respiratory hospital admissions, ages over 65	MRAD - Minor restricted activity days, ages 18-64	RMU - Respiratory medication use by adults
Austria	2.51E+05	2.61E+05	1.27E+00	1.87E+00	1.13E+00	4.20E+03	1.50E+03	1.06E+00	4.22E+03	1.53E+03
Belgium	4.55E+05	4.73E+05	2.30E+00	3.38E+00	2.04E+00	7.61E+03	2.71E+03	1.91E+00	7.64E+03	2.78E+03
Bulgaria	1.39E+05	1.44E+05	7.03E-01	1.03E+00	6.23E-01	2.32E+03	8.27E+02	5.84E-01	2.33E+03	8.47E+02
Cyprus	1.28E+05	1.33E+05	6.50E-01	9.54E-01	5.76E-01	2.15E+03	7.65E+02	5.40E-01	2.16E+03	7.83E+02
Czech Republic	2.67E+05	2.77E+05	1.35E+00	1.98E+00	1.20E+00	4.47E+03	1.59E+03	1.12E+00	4.48E+03	1.63E+03
Denmark	2.51E+05	2.60E+05	1.27E+00	1.86E+00	1.12E+00	4.19E+03	1.49E+03	1.05E+00	4.21E+03	1.53E+03
Estonia	9.17E+04	9.52E+04	4.64E-01	6.81E-01	4.11E-01	1.53E+03	5.46E+02	3.85E-01	1.54E+03	5.59E+02
Finland	8.89E+04	9.23E+04	4.50E-01	6.60E-01	3.99E-01	1.49E+03	5.29E+02	3.74E-01	1.49E+03	5.42E+02
France	2.78E+05	2.89E+05	1.41E+00	2.07E+00	1.25E+00	4.65E+03	1.66E+03	1.17E+00	4.67E+03	1.69E+03
Germany	3.52E+05	3.65E+05	1.78E+00	2.61E+00	1.58E+00	5.88E+03	2.10E+03	1.48E+00	5.91E+03	2.15E+03
Greece	1.71E+05	1.78E+05	8.65E-01	1.27E+00	7.67E-01	2.86E+03	1.02E+03	7.19E-01	2.87E+03	1.04E+03
Hungary	2.21E+05	2.29E+05	1.12E+00	1.64E+00	9.90E-01	3.69E+03	1.31E+03	9.28E-01	3.70E+03	1.35E+03
Ireland	1.91E+05	1.98E+05	9.64E-01	1.42E+00	8.55E-01	3.19E+03	1.13E+03	8.01E-01	3.20E+03	1.16E+03
Italy	2.90E+05	3.01E+05	1.47E+00	2.15E+00	1.30E+00	4.85E+03	1.73E+03	1.22E+00	4.87E+03	1.77E+03
Latvia	1.34E+05	1.39E+05	6.78E-01	9.96E-01	6.02E-01	2.24E+03	7.98E+02	5.64E-01	2.25E+03	8.17E+02
Lithuania	1.34E+05	1.39E+05	6.79E-01	9.97E-01	6.02E-01	2.24E+03	7.99E+02	5.64E-01	2.25E+03	8.18E+02
Luxemburg	4.36E+05	4.53E+05	2.21E+00	3.24E+00	1.96E+00	7.29E+03	2.60E+03	1.83E+00	7.32E+03	2.66E+03
Malta	2.16E+05	2.24E+05	1.09E+00	1.60E+00	9.68E-01	3.61E+03	1.28E+03	9.07E-01	3.62E+03	1.32E+03
Netherlands	3.79E+05	3.94E+05	1.92E+00	2.82E+00	1.70E+00	6.34E+03	2.26E+03	1.59E+00	6.36E+03	2.31E+03
Poland	2.12E+05	2.20E+05	1.07E+00	1.58E+00	9.51E-01	3.55E+03	1.26E+03	8.92E-01	3.56E+03	1.29E+03

Country	**External Costs NEEDS**	**External Costs CAFE**	**Mortality NEEDS** YOLL NEEDS	**Mortality CAFE** YOLL CAFE	**Morbidity NEEDS** RHA - Respiratory hospital admissions, ages over 65	MRAD - Minor restricted activity days, ages 18-64	RMU - Respiratory medication use by adults	**Morbidity CAFE** RHA - Respiratory hospital admissions, ages over 65	MRAD - Minor restricted activity days, ages 18-64	RMU - Respiratory medication use by adults
Portugal	1.52E+05	1.58E+05	7.70E-01	1.13E+00	6.82E-01	2.54E+03	9.06E+02	6.40E-01	2.55E+03	9.27E+02
Romania	1.72E+05	1.78E+05	8.68E-01	1.27E+00	7.70E-01	2.87E+03	1.02E+03	7.21E-01	2.88E+03	1.05E+03
Slovakia	2.15E+05	2.24E+05	1.09E+00	1.60E+00	9.66E-01	3.60E+03	1.28E+03	9.05E-01	3.61E+03	1.31E+03
Slovenia	2.72E+05	2.82E+05	1.37E+00	2.02E+00	1.22E+00	4.54E+03	1.62E+03	1.14E+00	4.56E+03	1.66E+03
Spain	1.53E+05	1.59E+05	7.76E-01	1.14E+00	6.88E-01	2.56E+03	9.13E+02	6.45E-01	2.57E+03	9.35E+02
Sweden	1.33E+05	1.38E+05	6.71E-01	9.86E-01	5.95E-01	2.22E+03	7.90E+02	5.58E-01	2.23E+03	8.09E+02
UK	2.89E+05	3.00E+05	1.46E+00	2.15E+00	1.30E+00	4.83E+03	1.72E+03	1.21E+00	4.85E+03	1.76E+03
Croatia	2.50E+05	2.60E+05	1.27E+00	1.86E+00	1.12E+00	4.19E+03	1.49E+03	1.05E+00	4.20E+03	1.53E+03
Turkey	1.72E+05	1.78E+05	8.69E-01	1.28E+00	7.71E-01	2.87E+03	1.02E+03	7.22E-01	2.88E+03	1.05E+03

Table 152 Country specific human health benefits per ktone of avoided VOC emission. Average meteorological conditions, 2010 emission scenario and EU-27+2-receptor-grid.

	External Costs NEEDS	**External Costs CAFE**	**Mortality NEEDS**	**Mortality CAFE**	**Morbidity NEEDS**			**Morbidity CAFE**		
Country			YOLL NEEDS	YOLL CAFE	RHA - Respiratory hospital admissions, ages over 65	MRAD - Minor restricted activity days, ages 18-64	RMU - Respiratory medication use by adults	RHA - Respiratory hospital admissions, ages over 65	MRAD - Minor restricted activity days, ages 18-64	RMU - Respiratory medication use by adults
Austria	1.91E+05	1.98E+05	9.65E-01	1.42E+00	8.56E-01	3.19E+03	1.14E+03	8.02E-01	3.20E+03	1.16E+03
Belgium	3.97E+05	4.12E+05	2.01E+00	2.95E+00	1.78E+00	6.63E+03	2.36E+03	1.67E+00	6.66E+03	2.42E+03
Bulgaria	7.99E+04	8.30E+04	4.04E-01	5.93E-01	3.58E-01	1.34E+03	4.76E+02	3.36E-01	1.34E+03	4.87E+02
Cyprus	3.49E+04	3.62E+04	1.77E-01	2.59E-01	1.56E-01	5.83E+02	2.08E+02	1.47E-01	5.85E+02	2.13E+02
Czech Republic	2.02E+05	2.10E+05	1.02E+00	1.50E+00	9.05E-01	3.37E+03	1.20E+03	8.49E-01	3.39E+03	1.23E+03
Denmark	1.93E+05	2.01E+05	9.79E-01	1.44E+00	8.68E-01	3.23E+03	1.15E+03	8.13E-01	3.25E+03	1.18E+03
Estonia	5.55E+04	5.76E+04	2.81E-01	4.12E-01	2.49E-01	9.28E+02	3.31E+02	2.33E-01	9.32E+02	3.38E+02
Finland	5.56E+04	5.77E+04	2.81E-01	4.13E-01	2.49E-01	9.29E+02	3.31E+02	2.34E-01	9.33E+02	3.39E+02
France	2.24E+05	2.33E+05	1.14E+00	1.67E+00	1.01E+00	3.75E+03	1.34E+03	9.44E-01	3.77E+03	1.37E+03
Germany	2.91E+05	3.02E+05	1.47E+00	2.16E+00	1.30E+00	4.86E+03	1.73E+03	1.22E+00	4.88E+03	1.77E+03
Greece	8.80E+04	9.14E+04	4.45E-01	6.54E-01	3.95E-01	1.47E+03	5.24E+02	3.70E-01	1.48E+03	5.37E+02
Hungary	1.53E+05	1.59E+05	7.72E-01	1.13E+00	6.85E-01	2.55E+03	9.09E+02	6.42E-01	2.56E+03	9.31E+02
Ireland	1.54E+05	1.60E+05	7.80E-01	1.15E+00	6.92E-01	2.58E+03	9.18E+02	6.48E-01	2.59E+03	9.40E+02
Italy	2.15E+05	2.23E+05	1.09E+00	1.60E+00	9.65E-01	3.59E+03	1.28E+03	9.04E-01	3.61E+03	1.31E+03
Latvia	8.20E+04	8.52E+04	4.15E-01	6.09E-01	3.68E-01	1.37E+03	4.89E+02	3.45E-01	1.38E+03	5.00E+02
Lithuania	8.28E+04	8.60E+04	4.19E-01	6.15E-01	3.72E-01	1.38E+03	4.93E+02	3.48E-01	1.39E+03	5.05E+02
Luxemburg	3.73E+05	3.87E+05	1.89E+00	2.77E+00	1.67E+00	6.23E+03	2.22E+03	1.57E+00	6.26E+03	2.27E+03
Malta	8.63E+04	8.96E+04	4.37E-01	6.41E-01	3.87E-01	1.44E+03	5.14E+02	3.63E-01	1.45E+03	5.26E+02
Netherlands	3.24E+05	3.37E+05	1.64E+00	2.41E+00	1.45E+00	5.42E+03	1.93E+03	1.36E+00	5.44E+03	1.98E+03
Poland	1.51E+05	1.57E+05	7.63E-01	1.12E+00	6.77E-01	2.52E+03	8.98E+02	6.34E-01	2.53E+03	9.20E+02
Portugal	7.91E+04	8.21E+04	4.00E-01	5.87E-01	3.55E-01	1.32E+03	4.71E+02	3.33E-01	1.33E+03	4.82E+02
Romania	1.08E+05	1.12E+05	5.44E-01	7.99E-01	4.83E-01	1.80E+03	6.40E+02	4.52E-01	1.81E+03	6.56E+02
Slovakia	1.47E+05	1.52E+05	7.42E-01	1.09E+00	6.58E-01	2.45E+03	8.73E+02	6.16E-01	2.46E+03	8.94E+02
Slovenia	2.01E+05	2.09E+05	1.02E+00	1.49E+00	9.03E-01	3.36E+03	1.20E+03	8.46E-01	3.38E+03	1.23E+03

	External Costs NEEDS	**External Costs CAFE**	**Mortality NEEDS**	**Mortality CAFE**	**Morbidity NEEDS**			**Morbidity CAFE**		
Country			YOLL NEEDS	YOLL CAFE	RHA - Respiratory hospital admissions, ages over 65	MRAD - Minor restricted activity days, ages 18-64	RMU - Respiratory medication use by adults	RHA - Respiratory hospital admissions, ages over 65	MRAD - Minor restricted activity days, ages 18-64	RMU - Respiratory medication use by adults
Spain	1.12E+05	1.17E+05	5.68E-01	8.35E-01	5.04E-01	1.88E+03	6.69E+02	4.72E-01	1.89E+03	6.85E+02
Sweden	9.46E+04	9.82E+04	4.78E-01	7.02E-01	4.24E-01	1.58E+03	5.63E+02	3.98E-01	1.59E+03	5.76E+02
UK	2.44E+05	2.53E+05	1.23E+00	1.81E+00	1.09E+00	4.08E+03	1.45E+03	1.02E+00	4.09E+03	1.49E+03
Croatia	1.72E+05	1.78E+05	8.68E-01	1.27E+00	7.70E-01	2.87E+03	1.02E+03	7.21E-01	2.88E+03	1.05E+03
Turkey	9.14E+04	9.49E+04	4.62E-01	6.79E-01	4.10E-01	1.53E+03	5.44E+02	3.84E-01	1.53E+03	5.57E+02

Table 153 Country specific human health benefits per ktone of avoided VOC emission. Average meteorological conditions, 2020 emission scenario and EU-27+2-receptor-grid.

	External Costs NEEDS	**External Costs CAFE**	**Mortality NEEDS**	**Mortality CAFE**	**Morbidity NEEDS**			**Morbidity CAFE**		
Country			YOLL NEEDS	YOLL CAFE	RHA - Respiratory hospital admissions, ages over 65	MRAD - Minor restricted activity days, ages 18-64	RMU - Respiratory medication use by adults	RHA - Respiratory hospital admissions, ages over 65	MRAD - Minor restricted activity days, ages 18-64	RMU - Respiratory medication use by adults
Austria	1.44E+05	1.50E+05	7.29E-01	1.07E+00	6.46E-01	2.41E+03	8.57E+02	6.05E-01	2.42E+03	8.78E+02
Belgium	3.40E+05	3.53E+05	1.72E+00	2.53E+00	1.53E+00	5.69E+03	2.03E+03	1.43E+00	5.71E+03	2.08E+03
Bulgaria	5.69E+04	5.90E+04	2.88E-01	4.22E-01	2.55E-01	9.50E+02	3.39E+02	2.39E-01	9.54E+02	3.47E+02
Cyprus	1.91E+04	1.99E+04	9.68E-02	1.42E-01	8.58E-02	3.20E+02	1.14E+02	8.05E-02	3.21E+02	1.17E+02
Czech Republic	1.20E+05	1.25E+05	6.09E-01	8.94E-01	5.40E-01	2.01E+03	7.17E+02	5.06E-01	2.02E+03	7.34E+02
Denmark	1.29E+05	1.34E+05	6.55E-01	9.62E-01	5.81E-01	2.16E+03	7.71E+02	5.44E-01	2.17E+03	7.89E+02
Estonia	3.61E+04	3.75E+04	1.83E-01	2.68E-01	1.62E-01	6.03E+02	2.15E+02	1.52E-01	6.06E+02	2.20E+02
Finland	3.60E+04	3.74E+04	1.82E-01	2.67E-01	1.61E-01	6.02E+02	2.14E+02	1.51E-01	6.04E+02	2.19E+02
France	1.57E+05	1.63E+05	7.94E-01	1.17E+00	7.04E-01	2.62E+03	9.35E+02	6.60E-01	2.63E+03	9.57E+02
Germany	2.19E+05	2.27E+05	1.11E+00	1.63E+00	9.82E-01	3.66E+03	1.30E+03	9.20E-01	3.67E+03	1.33E+03
Greece	6.45E+04	6.70E+04	3.27E-01	4.79E-01	2.90E-01	1.08E+03	3.84E+02	2.71E-01	1.08E+03	3.93E+02
Hungary	9.48E+04	9.85E+04	4.80E-01	7.04E-01	4.25E-01	1.59E+03	5.65E+02	3.99E-01	1.59E+03	5.78E+02
Ireland	1.03E+05	1.07E+05	5.19E-01	7.62E-01	4.60E-01	1.71E+03	6.11E+02	4.31E-01	1.72E+03	6.25E+02
Italy	1.47E+05	1.53E+05	7.44E-01	1.09E+00	6.60E-01	2.46E+03	8.76E+02	6.19E-01	2.47E+03	8.97E+02
Latvia	4.26E+04	4.42E+04	2.15E-01	3.16E-01	1.91E-01	7.12E+02	2.54E+02	1.79E-01	7.15E+02	2.60E+02
Lithuania	4.76E+04	4.95E+04	2.41E-01	3.54E-01	2.14E-01	7.97E+02	2.84E+02	2.00E-01	8.00E+02	2.90E+02
Luxemburg	2.86E+05	2.97E+05	1.45E+00	2.13E+00	1.28E+00	4.78E+03	1.70E+03	1.20E+00	4.80E+03	1.74E+03
Malta	5.52E+04	5.73E+04	2.79E-01	4.10E-01	2.48E-01	9.23E+02	3.29E+02	2.32E-01	9.26E+02	3.36E+02
Netherlands	3.09E+05	3.21E+05	1.56E+00	2.29E+00	1.39E+00	5.17E+03	1.84E+03	1.30E+00	5.19E+03	1.88E+03
Poland	9.48E+04	9.84E+04	4.79E-01	7.04E-01	4.25E-01	1.58E+03	5.64E+02	3.98E-01	1.59E+03	5.78E+02
Portugal	5.28E+04	5.48E+04	2.67E-01	3.92E-01	2.37E-01	8.82E+02	3.14E+02	2.22E-01	8.86E+02	3.22E+02
Romania	8.03E+04	8.34E+04	4.06E-01	5.96E-01	3.60E-01	1.34E+03	4.78E+02	3.38E-01	1.35E+03	4.89E+02
Slovakia	9.24E+04	9.60E+04	4.68E-01	6.86E-01	4.15E-01	1.54E+03	5.50E+02	3.89E-01	1.55E+03	5.63E+02

	External Costs NEEDS	**External Costs CAFE**	**Mortality NEEDS**	**Mortality CAFE**	**Morbidity NEEDS**			**Morbidity CAFE**		
Country			YOLL NEEDS	YOLL CAFE	RHA - Respiratory hospital admissions, ages over 65	MRAD - Minor restricted activity days, ages 18-64	RMU - Respiratory medication use by adults	RHA - Respiratory hospital admissions, ages over 65	MRAD - Minor restricted activity days, ages 18-64	RMU - Respiratory medication use by adults
Slovenia	1.40E+05	1.46E+05	7.10E-01	1.04E+00	6.30E-01	2.35E+03	8.36E+02	5.90E-01	2.36E+03	8.56E+02
Spain	7.78E+04	8.08E+04	3.94E-01	5.78E-01	3.49E-01	1.30E+03	4.63E+02	3.27E-01	1.31E+03	4.74E+02
Sweden	6.60E+04	6.85E+04	3.34E-01	4.90E-01	2.96E-01	1.10E+03	3.93E+02	2.77E-01	1.11E+03	4.02E+02
UK	1.84E+05	1.91E+05	9.30E-01	1.37E+00	8.25E-01	3.07E+03	1.09E+03	7.73E-01	3.09E+03	1.12E+03
Croatia	1.26E+05	1.31E+05	6.37E-01	9.35E-01	5.65E-01	2.10E+03	7.50E+02	5.29E-01	2.11E+03	7.67E+02
Turkey	6.87E+04	7.13E+04	3.48E-01	5.10E-01	3.08E-01	1.15E+03	4.09E+02	2.89E-01	1.15E+03	4.19E+02

Annex 20

20. Avoided external costs per country and per option for 2015 and 2020

Table 154: Total avoided external costs per country (i.e. European-wide benefits due to reduction of VOC emissions in the country) and option for 2015, in Euros[114]

country	Option 2	Option 3	Option 4	Option 8		Option 9		Option 11	Option 12a	
				scenario a)	scenario b)	scenario a)	scenario b)		scenario a)	scenario b)
Austria	44,008	458	39,176	93,566	142,168	1,650	12,192	81,751	488,265	468,923
Belgium	100,367	1,920	203,475	139,413	209,220	4,300	31,769	215,612	1,287,767	1,236,753
Bulgaria	2,093	23	6,088	5,763	8,908	713	5,267	36,912	110,230	105,863
Cyprus			52,308	5,482	8,626	106	781	3,061	9,141	8,779
Czech Republic	15,324	167	45,767	43,915	67,889	3,894	28,771	87,353	260,863	250,529
Denmark	30,492	188	45,385	65,611	98,549	13,796	101,923	47,597	284,277	273,016
Estonia	683	7	1,913	5,704	8,246	259	1,916	4,086	12,203	11,720
Finland	4,487	54	12,813	24,627	38,071	648	4,791	16,160	96,519	92,696
France	230,257	2,397	336,815	888,705	1,373,846	8,856	65,430	627,620	3,748,524	3,600,030
Germany	460,021	5,269	813,635	833,960	1,231,812	2,285	16,882	331,721	6,506,119	6,248,387
Greece	22,329	149	84,210	310,036	487,783	1,247	9,212	70,856	423,193	406,429
Hungary	10,460	114	107,663	68,491	105,381	1,672	12,351	71,161	212,508	204,090
Ireland	9,756	65	53,967	54,848	84,790	687	5,074	32,442	193,761	186,085
Italy	254,053	2,894	713,508	998,341	1,568,822	6,530	48,241	609,316	3,639,202	3,495,039
Latvia	1,115	12	2,707	7,899	11,421	245	1,813	8,020	23,950	23,001
Lithuania	1,657	18	4,620	13,989	20,226	330	2,441	13,183	39,370	37,810
Malta			1,764	1,675	2,589	316	2,333	2,789	8,328	7,998
Luxemburg			0	26,924	41,621	0	0	8,842	52,811	50,719
Netherlands	119,455	2,478	430,832	143,934	214,465	7,122	52,614	298,666	1,783,816	1,713,152
Poland	31,240	341	277,882	74,178	111,328	6,689	49,417	264,365	789,475	758,201
Portugal	28,184	243	33,410	62,915	99,744	636	4,697	60,079	358,830	344,616
Romania	11,606	127	28,003	27,198	42,045	2,591	19,143	136,551	407,781	391,627
Slovakia	5,656	62	63,965	14,433	22,312	339	2,507	38,634	115,373	110,803
Slovenia	4,821	53	15,352	50,259	77,193	712	5,261	19,824	59,200	56,855

[114] The monetary values reported in this table are expressed in Euro on the basis of the value of the Euro in the year 2000. The estimation of the monetary values expressed in Euros of 2000 enables a comparison of the monetary values estimated for 2015 and 2020.

country	Option 2	Option 3	Option 4	Option 8		Option 9		Option 11	Option 12a	
				scenario a)	scenario b)	scenario a)	scenario b)		scenario a)	scenario b)
Spain	132,335	1,371	396,600	424,436	671,116	3,662	27,051	263,245	1,572,260	1,509,976
Sweden	17,406	94	106,035	72,766	112,489	982	7,258	44,954	268,492	257,856
UK	248,849	2,240	1,157,934	240,343	400,179	10,899	80,518	481,986	4,163,935	3,998,986
Croatia	5,768	63	19,164	17,499	27,051	767	5,666	50,863	126,978	121,947
Turkey	43,352	473	124,221	129,256	199,816	8,207	60,633	544,257	1,358,709	1,304,885
sum:	1,835,774	21,279	5,179,209	4,846,165	7,487,706	90,141	665,953	4,471,906	28,401,879	27,276,772

Total avoided external costs per country (i.e. European-wide benefits due to reduction of VOC emissions in the country) and option for 2015, in Euros - continued[115]

country	Option 12b	Option 12c				Option 13		Option 14
		scenario a)	scenario b)	scenario c)	scenario d)	scenario a)	scenario b)	
Austria	18,272	35,794	71,589	107,383	143,177	7,134	15,186	16,871
Belgium	48,191	94,405	188,810	283,215	377,620	19,496	41,503	44,496
Bulgaria	4,125	8,081	16,162	24,243	32,323	4,657	9,913	7,617
Cyprus	342	670	1,340	2,010	2,681	386	822	632
Czech Republic	9,762	19,124	38,247	57,371	76,495	5,870	12,496	18,027
Denmark	10,638	305,118	610,235	915,353	1,220,470	6,005	12,783	143,810
Estonia	457	895	1,789	2,684	3,579	516	1,097	843
Finland	3,612	7,076	14,151	21,227	28,303	2,039	4,340	3,335
France	140,278	274,801	549,602	824,403	1,099,204	48,680	103,628	129,521
Germany	243,473	32,577	65,154	97,731	130,308	104,549	222,562	15,354
Greece	15,837	31,024	62,048	93,072	124,096	9,812	20,889	14,622
Hungary	7,952	15,579	31,158	46,736	62,315	8,843	18,824	14,685
Ireland	7,251	14,204	28,409	42,613	56,818	4,093	8,712	6,695
Italy	136,187	266,787	533,573	800,360	1,067,146	76,319	162,468	125,744
Latvia	896	1,756	3,511	5,267	7,023	1,012	2,154	1,655
Lithuania	1,473	2,886	5,772	8,658	11,545	1,663	3,541	2,721

[115] The monetary values reported in this table are expressed in Euro on the basis of the value of the Euro in the year 2000. The estimation of the monetary values expressed in Euros of 2000 enables a comparison of the monetary values estimated for 2015 and 2020.

country	Option 12b	Option 12c				Option 13		Option 14
		scenario a)	scenario b)	scenario c)	scenario d)	scenario a)	scenario b)	
Luxemburg	1,976	3,871	7,743	11,614	15,486	1,115	2,375	1,825
Malta	312	610	1,221	1,831	2,442	352	749	575
Netherlands	66,754	130,770	261,540	392,310	523,080	24,642	52,457	61,636
Poland	29,544	57,876	115,751	173,627	231,503	27,847	59,280	54,557
Portugal	13,428	26,306	52,611	78,917	105,222	4,851	10,327	12,399
Romania	15,260	29,894	59,788	89,682	119,576	10,839	23,073	28,180
Slovakia	4,317	8,458	16,916	25,374	33,832	3,065	6,525	7,973
Slovenia	2,215	4,340	8,680	13,020	17,360	2,501	5,324	4,091
Spain	58,837	115,261	230,522	345,783	461,044	31,759	67,608	54,326
Sweden	10,048	19,683	39,366	59,049	78,732	5,671	12,073	9,277
UK	155,823	305,254	610,509	915,763	1,221,017	87,952	187,232	143,875
Croatia	4,752	9,309	18,617	27,926	37,234	4,484	9,545	8,775
Turkey	50,846	99,606	199,211	298,817	398,423	47,976	102,130	93,894
sum:	1,062,858	1,922,013	3,844,026	5,766,039	7,688,052	554,125	1,179,615	1,028,011

Table 155: Total avoided external costs per country (i.e. European-wide benefits due to reduction of VOC emissions in the country) and option for 2020, in Euros[116]

country	Option 2	Option 3	Option 4	Option 8	Option 9				Option 11
					scenario a)	scenario b)	scenario c)	scenario d)	
Austria	117,207	207	37,502	101,105	546	10,108	35,316	44,878	78,860
Belgium	259,632	866	196,331	77,129	1,423	26,339	92,021	116,937	208,982
Bulgaria	5,524	10	5,896	7,487	232	4,295	15,004	19,066	34,058
Cyprus			50,537	8,355	35	647	2,262	2,874	3,118
Czech Republic	40,453	75	44,318	57,055	1,293	23,919	83,568	106,195	83,152
Denmark	82,123	85	43,668	87,853	4,368	80,825	282,385	358,843	45,671
Estonia	1,803	3	1,854	7,379	86	1,593	5,566	7,073	3,837
Finland	11,767	24	12,342	31,995	215	3,972	13,877	17,634	15,519

[116] The monetary values reported in this table are expressed in Euro on the basis of the value of the Euro in the year 2000. The estimation of the monetary values expressed in Euros of 2000 enables a comparison of the monetary values estimated for 2015 and 2020.

country	Option 2	Option 3	Option 4	Option 8	Option 9				Option 11
					scenario a)	scenario b)	scenario c)	scenario d)	
France	617,560	1,082	324,702	1,154,602	2,931	54,246	189,522	240,836	607,781
Germany	1,221,708	2,378	787,212	605,737	756	13,996	48,900	62,139	318,362
Greece	54,825	67	81,024	491,701	413	7,637	26,683	33,908	67,617
Hungary	27,612	51	104,703	95,544	555	10,268	35,876	45,589	66,954
Ireland	24,037	29	52,597	71,259	227	4,207	14,697	18,677	32,888
Italy	661,640	1,306	688,543	1,125,105	2,161	39,995	139,733	177,566	582,099
Latvia	2,942	5	2,625	10,220	81	1,507	5,266	6,692	7,432
Lithuania	4,374	8	4,475	18,099	110	2,029	7,090	9,010	12,282
Luxemburg			0	34,979	0	0	0	0	8,828
Malta			1,705	2,176	105	1,939	6,775	8,610	2,681
Netherlands	315,112	1,118	421,498	191,473	2,357	43,620	152,399	193,662	286,058
Poland	82,469	154	266,778	103,069	2,220	41,084	143,538	182,402	249,820
Portugal	73,611	110	32,341	91,901	210	3,894	13,605	17,289	57,772
Romania	30,639	57	27,191	35,335	843	15,608	54,529	69,294	127,757
Slovakia	14,931	28	76,026	18,751	113	2,084	7,281	9,253	36,651
Slovenia	12,726	24	14,842	68,978	236	4,374	15,282	19,419	18,833
Spain	352,489	619	385,906	585,118	1,212	22,427	78,355	99,570	258,196
Sweden	46,237	43	103,615	94,537	325	6,018	21,024	26,717	43,778
UK	654,789	1,011	1,128,277	334,656	3,607	66,755	233,225	296,372	462,576
Croatia	15,227	28	18,569	22,734	250	4,620	16,141	20,512	48,815
Turkey	114,444	213	120,418	167,929	2,672	49,436	172,718	219,483	522,339
sum:	4,845,882	9,604	5,035,496	5,702,260	29,584	547,443	1,912,638	2,430,498	4,292,716

Total avoided external costs per country (i.e. European-wide benefits due to reduction of VOC emissions in the country) and option for 2020, in Euros - continued[117]

country	Option 12a		Option 12b	Option 12c				Option 13	
	scenario a)	scenario b)		scenario a)	scenario b)	scenario c)	scenario d)	scenario a)	scenario b)
Austria	497,009	477,320	18,599	36,435	72,871	109,306	145,741	7,262	15,458
Belgium	1,317,085	1,264,910	49,288	96,554	193,109	289,663	386,217	19,940	42,448
Bulgaria	107,323	103,071	4,016	7,868	15,735	23,603	31,471	4,534	9,652
Denmark	287,839	276,436	10,772	303,677	607,355	911,032	1,214,710	6,080	12,943
Finland	97,805	93,931	3,660	7,170	14,340	21,510	28,680	2,066	4,398
France	3,830,473	3,678,733	143,344	280,808	561,617	842,425	1,123,234	49,744	105,894
Germany	6,475,411	6,218,895	242,323	32,985	65,970	98,956	131,941	104,055	221,512
Greece	426,149	409,268	15,947	31,241	62,481	93,722	124,962	9,881	21,035
Ireland	207,270	199,059	7,756	15,195	30,390	45,584	60,779	4,378	9,320
Italy	3,668,614	3,523,287	137,287	268,943	537,886	806,828	1,075,771	76,936	163,781
Luxemburg	55,640	53,436	2,082	4,079	8,158	12,237	16,316	1,175	2,502
Netherlands	1,802,850	1,731,432	67,466	132,165	264,331	396,496	528,661	24,904	53,016
Portugal	364,102	349,678	13,625	26,692	53,384	80,076	106,768	4,923	10,479
Spain	1,627,254	1,562,792	60,895	119,293	238,585	357,878	477,170	32,870	69,972
Sweden	275,905	264,975	10,325	20,226	40,453	60,679	80,905	5,828	12,406
UK	4,287,373	4,117,533	160,442	314,303	628,607	942,910	1,257,214	90,560	192,782

[117] The monetary values reported in this table are expressed in Euro on the basis of the value of the Euro in the year 2000. The estimation of the monetary values expressed in Euros of 2000 enables a comparison of the monetary values estimated for 2015 and 2020.

Annex 21

21. Avoided years of life lost (YOLL) per country and option for 2015 and 2020

Table 156: Total avoided years of life lost (YOLL) per country (i.e. European-wide benefits due to reduction of VOC emissions in the country) for 2015

country	Option 2	Option 3	Option 4	Option 8		Option 9		Option 11	Option 12a	
				scenario a)	scenario b)	scenario a)	scenario b)		scenario a)	scenario b)
Austria	0.315	0.003	0.280	0.669	1.017	0.012	0.087	0.585	3.492	3.354
Belgium	0.718	0.014	1.455	0.997	1.496	0.031	0.227	1.542	9.211	8.846
Bulgaria	0.015	0.000	0.044	0.041	0.064	0.005	0.038	0.264	0.788	0.757
Cyprus			0.374	0.039	0.062	0.001	0.006	0.022	0.065	0.063
Czech Republic	0.110	0.001	0.327	0.314	0.486	0.028	0.206	0.625	1.866	1.792
Denmark	0.218	0.001	0.325	0.469	0.705	0.099	0.729	0.340	2.033	1.953
Estonia	0.005	0.000	0.014	0.041	0.059	0.002	0.014	0.029	0.087	0.084
Finland	0.032	0.000	0.092	0.176	0.272	0.005	0.034	0.116	0.690	0.663
France	1.647	0.017	2.409	6.357	9.827	0.063	0.468	4.489	26.812	25.750
Germany	3.290	0.038	5.820	5.965	8.811	0.016	0.121	2.373	46.536	44.692
Greece	0.160	0.001	0.602	2.218	3.489	0.009	0.066	0.507	3.027	2.907
Hungary	0.075	0.001	0.770	0.490	0.754	0.012	0.088	0.509	1.520	1.460
Ireland	0.070	0.000	0.386	0.392	0.606	0.005	0.036	0.232	1.386	1.331
Italy	1.817	0.021	5.103	7.141	11.221	0.047	0.345	4.358	26.030	24.999
Latvia	0.008	0.000	0.019	0.056	0.082	0.002	0.013	0.057	0.171	0.165
Lithuania	0.012	0.000	0.033	0.100	0.145	0.002	0.017	0.094	0.282	0.270
Luxemburg			0.000	0.193	0.298	0.000	0.000	0.063	0.378	0.363
Malta			0.013	0.012	0.019	0.002	0.017	0.020	0.060	0.057
Netherlands	0.854	0.018	3.082	1.030	1.534	0.051	0.376	2.136	12.759	12.254
Poland	0.223	0.002	1.988	0.531	0.796	0.048	0.353	1.891	5.647	5.423
Portugal	0.202	0.002	0.239	0.450	0.713	0.005	0.034	0.430	2.567	2.465
Romania	0.083	0.001	0.200	0.195	0.301	0.019	0.137	0.977	2.917	2.801
Slovakia	0.040	0.000	0.458	0.103	0.160	0.002	0.018	0.276	0.825	0.793
Slovenia	0.034	0.000	0.110	0.359	0.552	0.005	0.038	0.142	0.423	0.407
Spain	0.947	0.010	2.837	3.036	4.800	0.026	0.193	1.883	11.246	10.800
Sweden	0.125	0.001	0.758	0.520	0.805	0.007	0.052	0.322	1.920	1.844
UK	1.780	0.016	8.282	1.719	2.862	0.078	0.576	3.447	29.783	28.603
Croatia	0.041	0.000	0.137	0.125	0.193	0.005	0.041	0.364	0.908	0.872

country	Option 2	Option 3	Option 4	Option 8		Option 9		Option 11	Option 12a	
				scenario a)	scenario b)	scenario a)	scenario b)		scenario a)	scenario b)
Turkey	0.310	0.003	0.889	0.925	1.429	0.059	0.434	3.893	9.718	9.333
sum:	13.131	0.152	37.045	34.663	53.557	0.645	4.763	31.986	203.147	195.100

Total avoided years of life lost (YOLL) per country (i.e. European-wide benefits due to reduction of VOC emissions in the country) for 2015 - continued

county	Option 12b	Option 12c				Option 13	
		scenario a)	scenario b)	scenario c)	scenario d)	scenario a)	scenario b)
Austria	0.131	0.256	0.512	0.768	1.024	0.051	0.109
Belgium	0.345	0.675	1.350	2.026	2.701	0.139	0.297
Bulgaria	0.030	0.058	0.116	0.173	0.231	0.033	0.071
Cyprus	0.002	0.005	0.010	0.014	0.019	0.003	0.006
Czech Republic	0.070	0.137	0.274	0.410	0.547	0.042	0.089
Denmark	0.076	2.182	4.365	6.547	8.730	0.043	0.091
Estonia	0.003	0.006	0.013	0.019	0.026	0.004	0.008
Finland	0.026	0.051	0.101	0.152	0.202	0.015	0.031
France	1.003	1.966	3.931	5.897	7.862	0.348	0.741
Germany	1.741	0.233	0.466	0.699	0.932	0.748	1.592
Greece	0.113	0.222	0.444	0.666	0.888	0.070	0.149
Hungary	0.057	0.111	0.223	0.334	0.446	0.063	0.135
Ireland	0.052	0.102	0.203	0.305	0.406	0.029	0.062
Italy	0.974	1.908	3.816	5.725	7.633	0.546	1.162
Latvia	0.006	0.013	0.025	0.038	0.050	0.007	0.015
Lithuania	0.011	0.021	0.041	0.062	0.083	0.012	0.025
Luxemburg	0.014	0.028	0.055	0.083	0.111	0.008	0.017
Malta	0.002	0.004	0.009	0.013	0.017	0.003	0.005
Netherlands	0.477	0.935	1.871	2.806	3.741	0.176	0.375
Poland	0.211	0.414	0.828	1.242	1.656	0.199	0.424
Portugal	0.096	0.188	0.376	0.564	0.753	0.035	0.074
Romania	0.109	0.214	0.428	0.641	0.855	0.078	0.165
Slovakia	0.031	0.060	0.121	0.181	0.242	0.022	0.047
Slovenia	0.016	0.031	0.062	0.093	0.124	0.018	0.038

county	Option 12b	Option 12c				Option 13	
		scenario a)	scenario b)	scenario c)	scenario d)	scenario a)	scenario b)
Spain	0.421	0.824	1.649	2.473	3.298	0.227	0.484
Sweden	0.072	0.141	0.282	0.422	0.563	0.041	0.086
UK	1.115	2.183	4.367	6.550	8.733	0.629	1.339
Croatia	0.034	0.067	0.133	0.200	0.266	0.032	0.068
Turkey	0.364	0.712	1.425	2.137	2.850	0.343	0.730
sum:	7.602	13.747	27.495	41.242	54.990	3.963	8.437

Table 157: Total avoided years of life lost (YOLL) per country (i.e. European-wide benefits due to reduction of VOC emissions in the country) for 2020

country	Option 2	Option 3	Option 4	Option 8	Option 9				Option 11
					scenario a)	scenario b)	scenario c)	scenario d)	
Austria	0.838	0.001	0.268	0.723	0.004	0.072	0.253	0.321	0.564
Belgium	1.857	0.006	1.404	0.552	0.010	0.188	0.658	0.836	1.495
Bulgaria	0.040	0.000	0.042	0.054	0.002	0.031	0.107	0.136	0.244
Cyprus			0.361	0.060	0.000	0.005	0.016	0.021	0.022
Czech Republic	0.289	0.001	0.317	0.408	0.009	0.171	0.598	0.760	0.595
Denmark	0.587	0.001	0.312	0.628	0.031	0.578	2.020	2.567	0.327
Estonia	0.013	0.000	0.013	0.053	0.001	0.011	0.040	0.051	0.027
Finland	0.084	0.000	0.088	0.229	0.002	0.028	0.099	0.126	0.111
France	4.417	0.008	2.322	8.258	0.021	0.388	1.356	1.723	4.347
Germany	8.738	0.017	5.631	4.333	0.005	0.100	0.350	0.444	2.277
Greece	0.392	0.000	0.580	3.517	0.003	0.055	0.191	0.243	0.484
Hungary	0.197	0.000	0.749	0.683	0.004	0.073	0.257	0.326	0.479
Ireland	0.172	0.000	0.376	0.510	0.002	0.030	0.105	0.134	0.235
Italy	4.732	0.009	4.925	8.047	0.015	0.286	0.999	1.270	4.164
Latvia	0.021	0.000	0.019	0.073	0.001	0.011	0.038	0.048	0.053
Lithuania	0.031	0.000	0.032	0.129	0.001	0.015	0.051	0.064	0.088
Luxemburg			0.000	0.250	0.000	0.000	0.000	0.000	0.063
Malta			0.012	0.016	0.001	0.014	0.048	0.062	0.019
Netherlands	2.254	0.008	3.015	1.370	0.017	0.312	1.090	1.385	2.046
Poland	0.590	0.001	1.908	0.737	0.016	0.294	1.027	1.305	1.787

country	Option 2	Option 3	Option 4	Option 8	Option 9				Option 11
					scenario a)	scenario b)	scenario c)	scenario d)	
Portugal	0.527	0.001	0.231	0.657	0.002	0.028	0.097	0.124	0.413
Romania	0.219	0.000	0.194	0.253	0.006	0.112	0.390	0.496	0.914
Slovakia	0.107	0.000	0.544	0.134	0.001	0.015	0.052	0.066	0.262
Slovenia	0.091	0.000	0.106	0.493	0.002	0.031	0.109	0.139	0.135
Spain	2.521	0.004	2.760	4.185	0.009	0.160	0.560	0.712	1.847
Sweden	0.331	0.000	0.741	0.676	0.002	0.043	0.150	0.191	0.313
UK	4.683	0.007	8.070	2.394	0.026	0.477	1.668	2.120	3.309
Croatia	0.109	0.000	0.133	0.163	0.002	0.033	0.115	0.147	0.349
Turkey	0.819	0.002	0.861	1.201	0.019	0.354	1.235	1.570	3.736
sum:	34.661	0.069	36.017	40.786	0.212	3.916	13.680	17.384	30.704

Total avoided years of life lost (YOLL) per country (i.e. European-wide benefits due to reduction of VOC emissions in the country) for 2020 – continued

country	Option 12a		Option 12b	Option 12c				Option 13	
	scenario a)	scenario b)		scenario a)	scenario b)	scenario c)	scenario d)	scenario a)	scenario b)
Austria	3.555	3.414	0.133	0.261	0.521	0.782	1.042	0.052	0.111
Belgium	9.421	9.047	0.353	0.691	1.381	2.072	2.762	0.143	0.304
Bulgaria	0.768	0.737	0.029	0.056	0.113	0.169	0.225	0.032	0.069
Cyprus	0.070	0.067	0.003	0.005	0.010	0.015	0.021	0.003	0.006
Czech Republic	1.874	1.800	0.070	0.137	0.275	0.412	0.550	0.042	0.090
Denmark	2.059	1.977	0.077	2.172	4.344	6.516	8.688	0.043	0.093
Estonia	0.086	0.083	0.003	0.006	0.013	0.019	0.025	0.004	0.008
Finland	0.700	0.672	0.026	0.051	0.103	0.154	0.205	0.015	0.031
France	27.398	26.313	1.025	2.009	4.017	6.026	8.034	0.356	0.757
Germany	46.316	44.481	1.733	0.236	0.472	0.708	0.944	0.744	1.584
Greece	3.048	2.927	0.114	0.223	0.447	0.670	0.894	0.071	0.150
Hungary	1.509	1.449	0.056	0.111	0.221	0.332	0.443	0.063	0.134
Ireland	1.483	1.424	0.055	0.109	0.217	0.326	0.435	0.031	0.067
Italy	26.240	25.201	0.982	1.924	3.847	5.771	7.695	0.550	1.171
Latvia	0.168	0.161	0.006	0.012	0.025	0.037	0.049	0.007	0.015
Lithuania	0.277	0.266	0.010	0.020	0.041	0.061	0.081	0.012	0.025

country	Option 12a		Option 12b	Option 12c				Option 13	
	scenario a)	scenario b)		scenario a)	scenario b)	scenario c)	scenario d)	scenario a)	scenario b)
Luxemburg	0.398	0.382	0.015	0.029	0.058	0.088	0.117	0.008	0.018
Malta	0.060	0.058	0.002	0.004	0.009	0.013	0.018	0.003	0.005
Netherlands	12.895	12.384	0.483	0.945	1.891	2.836	3.781	0.178	0.379
Poland	5.631	5.408	0.211	0.413	0.826	1.238	1.651	0.199	0.423
Portugal	2.604	2.501	0.097	0.191	0.382	0.573	0.764	0.035	0.075
Romania	2.880	2.765	0.108	0.211	0.422	0.633	0.844	0.077	0.163
Slovakia	0.826	0.793	0.031	0.061	0.121	0.182	0.242	0.022	0.047
Slovenia	0.424	0.408	0.016	0.031	0.062	0.093	0.124	0.018	0.038
Spain	11.639	11.178	0.436	0.853	1.707	2.560	3.413	0.235	0.500
Sweden	1.973	1.895	0.074	0.145	0.289	0.434	0.579	0.042	0.089
UK	30.666	29.451	1.148	2.248	4.496	6.744	8.992	0.648	1.379
Croatia	0.919	0.883	0.034	0.067	0.135	0.202	0.270	0.032	0.069
Turkey	9.835	9.446	0.368	0.721	1.442	2.163	2.884	0.347	0.739
sum:	205.722	197.573	7.699	13.943	27.886	41.829	55.772	4.012	8.540

Annex 22

22. Evaluation of Member States monitoring programmes

22.1. The monitoring programmes of the Member States

Accordant to article 6 of Directive 2004/42/EC, the Member States shall set up a monitoring programme *"for the purpose of verifying compliance with the Directive"*. Results of the programs shall be reported to the Commission (article 7).

The Commission's reporting format[118] asks Member States under number 2.1 for optional provision of their written monitoring programmes to the Commission. In response, 12 Member States sent in documents (AT, DE, FI, LT, NL, PT, SI, SK, BG, EL, IE, RO), subsequently translated by the Commission into English. Therewith they kindly contribute to the development of an exemplary Monitoring Programme. Good practises can be drawn from various Monitoring Programmes as for example the ones provided by Ireland, Lithuania, The Netherlands, Romania and Slovenia.

A "programme" according to the directive can be seen as a theoretical background and anticipation of later action. Guidelines or criteria for an effective monitoring programme have not been developed for Community level. However, reasonable criteria for such written programmes could be that they are comprehensive, clear and unambiguous, anticipating a balanced effort to obtain a picture of compliance or non-compliance, achieved by sampling a number of products which is sufficiently high and representative, providing procedures that minimise fraud, whilst considering the related costs for planning and executing the programme.

The following chapters evaluate details of the delivered monitoring programmes, set up by Member States to assure compliance with the requirements of the Directive 2004/42/EC. The evaluation highlights good practice examples of each Member State concerning different implementation parts of the Monitoring Programme.

[118] according to article 7 of the directive, requiring feedback based on a Commission's questionnaire (COM 2007/205/EC)

22.2. Monitoring programme of Austria

The document available from Austria is not a monitoring programme in sense of a strategic plan for accomplishing in future, but the analytical results of the samples taken and the monitoring set out. Those results are comprehensive and lead to the conclusion, that the monitoring programme meets the requirements of a strategic monitoring plan.

Evaluation summary

The Austrian monitoring programme can not be evaluated on basis on the document at hand.

22.3. Monitoring programme of Bulgaria

Data base

The data base is not defined, but available administration data shall be used.

The quality of the data base can not be commented.

The monitoring

Together with the Environment Executive Agency (IAOS), the Ministry of the Environment and Waters (MOSV) draft a monitoring programme. The checks are to be achieved by regional authorities.

The administrative issues seem to be clear and unambiguous. To set out the checks by regional authorities can be a practicable measurement.

Priority is to check manufacturers, wholesalers and importers. Others like retailers or end-users like finishers of vehicles of the diverse categories are to be checked in case of free capacities. Checks shall be achieved annually.

Compliance with labelling and VOC content requirements is to be checked. The choice, number, and amount of sample taking are not described, only for exception regulations. If products are not or wrongly labelled, product testing catalogues have to be required. If those cannot be provided, the products have to be tested. Samples are to be taken in the presence of an authority of the establishment being checked [Monitoring Programme BG, 2008].

The administration of sample taking, the amount of samples giving to each party, is well defined.

The monitoring programme tackles all relevant issues. The programme and its the monitoring strategy could be completed, like with the kind and the amounts of samples to be taken and the choice of market actors to be checked.

Open questions

It is not clear, which companies (e.g. defined by size or market share) will be checked and which amount of samples will be taken out of which product category.

Evaluation summary

The monitoring programme tackles the relevant issues. More details could be added in terms of the concrete strategy of monitoring accomplishing.

Table 158: Evaluation of the monitoring programme of Bulgaria

Preparation	
Required data base	
Planned evaluation	Not defined. (Monitoring Programme leads to the assumption, that as much knowledge as possible is to be gathered)
Measures to build up the data base	Using existing administrative capacity / Data comprises on below named monitoring subjects, data on breaching max. VOC content and labelling rules, register of permits for products failing to comply
Monitoring	
Monitoring authorities/persons/institute	Responsible: Ministry of the Environment and Waters (MOSV) (or officers authorised by him). Together with the Environment Executive Agency (IAOS), the Ministry of the Environment and Waters (MOSV) draft a monitoring programme. Inspections and *in-situ* checks at the regional and local levels are the responsibility of Regional Environment and Water Inspectorates (RIOSV)
Reporting	Authority persons from Regional Environment and Water Inspectorates (RIOSV) report to Environment Executive Agency (IAOS) by the close of April in the current year.
Monitoring subjects *Producers, importers, wholesalers, etc*	Priority on checking manufacturers, importers, wholesalers. Others: Retailers, Finishers of vehicles of the diverse categories, Operators offering services within the scope and do not exceed relevant threshold values for solvent consumption, Operators (building, contractors, furniture makers, others) using products under the scope.
Monitoring objects *2004/42/EC:* *annex II.A: Subcategory a-l, each sb/wb = 24 subcategories* *annex II.B: Subcategory a-e, (a and c each x 2 subcategories) = 7 subcategories* *In total: 31 subcategories regulated by the Directive*	Products covered under the Directive
Monitoring content	
Monitoring content in general *2004/42/EC (Art. 3):* *MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in*	Max. VOC content and ready to use state, labelling requirements, compliance with registration instructions. Compiling catalogues.

annex II and comply with Art. 4 [labelling requirements]	
Labelling *2004/42/EC (Art. 4):* *(1) The subcategory of the product and the relevant VOC limit values in g/l as referred to in Appendix II.* *(2) The maximum content of VOC in g/l of the product in a ready to use condition*	Compliance with Art. 4 requirements
VOC content *2004/42/EC annex II A and B: (Art. 3) MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II […]*	Compliance of VOC content
Monitoring methods *2004/42/EC (Art. 6):* *MS shall set up a monitoring programme for the purpose of verifying compliance with this Directive*	
Monitoring intervals/allocation or random	Annual checks of manufacturers and importers (and where possible, wholesalers). Checks related to implementation of recommendations. Checks pursuant to tip-offs.
Choice of monitored subject *Producers, importers, whole-salers, etc*	Not described.
Choice of samples (in general)	Not described for general sample taking. If products are not or wrongly labelled, product testing catalogues have to be required. If those can not be provided, the products have to be tested.
Monitoring of the labelling	
Sample taking for the checking of labelling	Not described.
Verification of compliance with labelling requirements	Not described.
Monitoring of the VOC content	
Sample taking for the checking of VOC content	Testing specimens have to be taken in the presence of authorised representatives of the establishment being checked. Four sample copies have to be taken for each party.
Verification of compliance with VOC content requirements	Analytical test methods.
Monitoring reports	To be provided by RIOSV to IAOS
Technical Analysis	
Analytical methods *2004/42/EC (annex III):* *ISO 11890-2 VOC content* *ASTMD 2369 VOC content where reactive diluents are present* *[ISO 11890-1 (not mentioned in annex III]*	Not defined in monitoring programme.

Consequences of non-compliance	
First measurement 2004/42/EC (Art. 10): MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].	Sanctions can be imposed. Administrative Offence Finding Deeds can be compiled.
After repeating non-compliance 2004/42/EC (Art. 10): MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].	Not described.
Discretionary Decision	
Additional information	In case of non-compliance of the VOC content, costs for the analysis can be charged to manufacturers.

22.4. Monitoring programme of Finland

Data base

The data base for monitoring includes the manufacturing, importing and sales data of manufacturers and importers.

The manufacturers and importers have to supply this data to the Finnish Environment Institute. They furthermore have to supply the data of the packaging information of the products and their VOC contents, at least of five representative products of the product line. [Monitoring programme FI, 2008]

Manufacturers and importers shall report manufacturing, import and sales data concerning regulated products electronically using a special form provided in the Internet by the Finnish Environment Institute. [Monitoring programme FI, 2008]

The definition of the underlying data base covers all regulated products. The measures taken, giving the responsibility of supplying the data of kind and amount of products produced to the manufacturers and importers seem to be clear, unambiguous and suitable.

The monitoring

The manufacturers and importers have to provide the Finnish Environment Institute the labels of the supplied products, at least of five representative products, as well as the data on which the respective VOC content bases on. The labels have to comply to the in the Directive detailed requirements, additionally, Finland claims bilingualism (Finish and Swedish).

Finland leaves the responsibility of sample taking at the manufacturers and importers. Yet, as required monitoring method, the sample taking for the label checking shall be done by an authority person. Further more, the label shall be checked while applied to the according product. This recommended method of label checking should be added to the current monitoring methods of Finland.

The method used to establish the VOC content must be explained; it can be calculated or established by one of the in the Directive required analytical methods. In case of "indicated omissions" of non-compliance of products, monitoring authorities are ordered by the Finnish Environmental Institute to undertake monitoring visits. [Monitoring programme FI, 2008] Further monitoring is carried out whenever possible alongside other monitoring and inspections. Retail premises "will be inspected if necessary". [Monitoring programme FI, 2008]. In later years, regional environment centres might be asked "on a case-by-case basis", to monitor the products in their own areas. [Monitoring programme FI, 2008]

Finland could improve its monitoring methods by adding the following issues: The sample taking for the checking of the VOC content shall be done by an authority person. The VOC content shall be verified via the required test methods (Annex III, Directive 2004/42/EC). The VOC content shall be verified with the required test methods categorically at least at a minimum amount of products, not just in cases of indicated omissions. As the samples should be taken by an authority person, this requirement includes personal monitoring visits of the authorities as standard. A sample taking strategy, including the definition of amounts of samples to be taken should be added to the monitoring programme.

Monitoring authorities, manufacturers and importers report their data or results in due time to the Finish Environment Institute which reports the summary of the results to the European Commission.

The reporting system seems to be clear and unambiguous.

Open questions

It is not clear, in which cases "indicated omissions" are presumed.

Evaluation summary

The administration to evaluate the data base for a monitoring programme seems to be effective and might be suggested to other Member States. All terms, which could lead to misunderstandings, are defined in the monitoring programme. This practice is very recommendable.

The Finish monitoring programme regularly determines sample taking and supplying to the authority as an issue of the manufacturers and importers, and not as an issue of the authority. This should be adjusted as it does not lead to effective monitoring of compliance.

The monitoring programme could be completed with details of amount of sample taking.

Table 159: Evaluation of the monitoring programme of Finland

Preparation	
Required data base	
Planned evaluation	All produced and imported products shall be registered, including the contents of the products.
Measures to build up the data base	Manufacturers and importers will supply the manufacturing, importing and sales data of products that fall within the scope of the Product-VOC Decree to the Finnish Environment Institute (Chapter 12 of Environmental Protection Act).
Monitoring	
Monitoring authorities/persons/institute	Responsible Authority: Finnish Environment Institute Executing Entities: (Chapter 22 of Environmental Protection Act) Regional environmental institutes and municipal environmental protection officers
Reporting	
Monitoring subjects *Producers, importers, wholesalers, etc*	Manufacturers and importers
Monitoring objects *2004/42/EC:* *annex II.A: Subcategory a-l, each sb/wb = 24 subcategories* *annex II.B: Subcategory a-e, (a and c each x 2 subcategories) = 7 subcategories* *In total: 31 subcategories regulated by the Directive*	Products, that fall within the scope of the Directive
Monitoring content	
Monitoring content in general *2004/42/EC (Art. 3):* *MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II and comply with Art. 4 [labelling requirements]*	Maximum VOC content and labelling (limit values on the packaging). Products shall be conform to the requirements of the “Product-VOC-Decree”. Exemption order procedure is used to monitor the number of non-complying products used and the locations, where those products are used.
Labelling *2004/42/EC (Art. 4):* *(1) The subcategory of the product and the relevant VOC limit values in g/l as referred to in Appendix II.* *(2) The maximum content of VOC in g/l of the product in a ready to use condition*	Subcategory (Appendix I), Limit value in g/l (Appendix II), total max VOC level of a ready-to-use product (g/l)
VOC content *2004/42/EC annex II A and B: (Art. 3) MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II […]*	VOC content has to comply

Monitoring methods *2004/42/EC (Art. 6):* *MS shall set up a monitoring programme for the purpose of verifying compliance with this Directive*	Manufacturers and Importers are asked to supply to the Finnish Environmental Institute the packaging information and VOC content of the products they supply (or of five representative products). To check the labelling, manufacturers and importers are asked to supply the data on which the VOC content is based. In cases of indicated omissions (due to the supplied data), the Finnish Environment Institute asks the monitoring institutes to check compliance.
Monitoring intervals/allocation or random	Annually.
Choice of monitored subject *Producers, importers, wholesalers, etc*	All manufacturers and importers
Choice of samples (in general)	Labels sent in to the Finish Environment Institute by manufacturers and importers
Monitoring of the labelling	Compliance check of the posted labels
Sample taking for the checking of labelling	In case of "indicated omissions"
Verification of compliance with labelling requirements	In case of "indicated omissions"
Monitoring of the VOC content	Send in of label of the product/information of the VOC content of the product and explanation of data used to establish that content and the method used. VOC content may be calculated or using one of the required analytical methods.
Sample taking for the checking of VOC content	In case of "indicated omissions"
Verification of compliance with VOC content requirements	In case of "indicated omissions"
Monitoring reports	Monitoring authorities provide their reports to the Finish Environment Institute, manufacturers and importers report their information as well to the Environment Institute.
Technical Analysis	
Analytical methods *2004/42/EC (annex III):* *ISO 11890-2 VOC content* *ASTMD 2369 VOC content where reactive diluents are present* *[ISO 11890-1 (not mentioned in annex III]*	Those analytical methods are used "whenever possible".
Consequences of non-compliance	
First measurement *2004/42/EC (Art. 10):* *MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].*	Not described.

After repeating non-compliance *2004/42/EC (Art. 10):* *MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].*	
Discretionary Decision	*Discretionary Decision, if a case of omission due to the supplied data is conjecturable*
Indicated omissions	"Indicated omissions" due to the supplied data to the Finnish Environment Institute by the manufacturers and importers. *This term is not defined.*
Additional information	In later years, the Finnish Environment Institute may ask, on case-by-case basis, regional environment centres and municipalities to monitor the products of manufacturers and importers in their own area.

22.5. Monitoring programme of Germany

Germany did not set a federal monitoring programme, because the responsibility for monitoring Directive 2004/42/EC is at the 16 state governments of the "Länder". The monitoring programme exemplary provided to the Commission is the programme of the state of Baden-Württemberg.

Data base

Baden-Württemberg uses the production data supplied by the manufacturers. The manufacturers have to report their produced quantities on prepared form-sheets. Baden-Württemberg provides the data in anonymous form to the Federal Institute for Occupational Safety and Health.

The measures to gain the data base are practicable and recommendable.

The monitoring

The responsible authority is the Ministry of Environment of Baden-Württemberg.

"Approximately five products per year spread over one or two undertakings" must be checked for compliance with the labelling rules and their VOC content, for the selection, "the limit value and potential users" shall be taken into account" [Monitoring Programme DE, 2008]. Manufacturers and importers shall be monitored.

VOC content compliance check has to be done with analytical methods required by the Directive.

As Baden-Württemberg is one of 16 regions, the monitoring strategy has to be understood as one part of a frame. Therewith, the amount and interval of sample taking meets the requirements.

The information should be added to the monitoring programme, how and by whom (authority person) the samples are taken, where there are taken and why this is assumed as representative. Those informations would complete the monitoring programme. The monitoring programme should state more clearly, that the samples will be taken by authority persons.

Open questions

Details are not specified concerning the selection of monitored manufacturers and about number of samples, sample taking and sample evaluation in detail.

Evaluation summary

The document could describe particulars of sample taking and decisions for amount and location of sample taking more detailed.

Table 160: Evaluation of the monitoring programme of Germany

Preparation	
Required data base	
Planned evaluation	Knowledge of manufacturers and production data (Baden-Württemberg)
Measures to build up the data base	Manufacturers have to report their data in 2008, 2011 and afterwards every five years. (Baden-Württemberg)
Monitoring	(monitoring programme on hand is the programme of the Land Baden-Württemberg)
Monitoring authorities/persons/institute	Usually the Environmental Ministry of each German state government
Reporting	The manufacturers have to keep their relevant documents available for the previous enquiry period […] for the competent authority on request.
Monitoring subjects *Producers, importers, wholesalers, etc*	Manufacturers and importers (Baden-Württemberg)
Monitoring objects *2004/42/EC:* *annex II.A: Subcategory a-l, each sb/wb = 24 subcategories* *annex II.B: Subcategory a-e, (a and c each x 2 subcategories) = 7 subcategories* *In total: 31 subcategories regulated by the Directive*	Products covered by the Directive

Monitoring content	
Monitoring content in general *2004/42/EC (Art. 3):* *MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II and comply with Art. 4 [labelling requirements]*	VOC content and labelling compliance verification
Labelling *2004/42/EC (Art. 4):* *(1) The subcategory of the product and the relevant VOC limit values in g/l as referred to in Appendix II.* *(2) The maximum content of VOC in g/l of the product in a ready to use condition*	Compliance with Art. 4 requirements
VOC content *2004/42/EC annex II A and B: (Art. 3) MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II […]*	Analytical tests of VOC content
Monitoring methods *2004/42/EC (Art. 6):* *MS shall set up a monitoring programme for the purpose of verifying compliance with this Directive*	
Monitoring intervals/allocation or random	Approximately five products per year spread over one or two undertakings
Choice of monitored subject *Producers, importers, wholesalers, etc*	Not described.
Choice of samples (in general)	Taking into account “the limit values and the potential user” [Monitoring Programme DE, 2008]
Monitoring of the labelling	
Sample taking for the checking of labelling	Not described.
Verification of compliance with labelling requirements	Not described.
Monitoring of the VOC content	
Sample taking for the checking of VOC content	Not described.
Verification of compliance with VOC content requirements	Analytical test methods.
Monitoring reports	Not described.

Technical Analysis	
Analytical methods *2004/42/EC (annex III):* *ISO 11890-2 VOC content* *ASTMD 2369 VOC content where reactive diluents are present* *[ISO 11890-1 (not mentioned in annex III]*	ISO 11890-2, ASTMD 2369
Consequences of non-compliance	
First measurement *2004/42/EC (Art. 10):* *MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].*	Not described.
After repeating non-compliance *2004/42/EC (Art. 10):* *MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].*	Not described.
Discretionary Decision	
Additional information	In case of non-compliance of the VOC content, costs for the analysis can be charged to manufacturers.
	"Manufacturers must inform their customers that products which do not comply […] may only be used in installations [which…]"

22.6. Monitoring programme of Ireland

Ireland set up a monitoring programme for the compliance check of VOC content in paints and varnishes. The document at hand is a report of the monitoring carried out. In the first monitoring period, Ireland sub-contracted the inspection work.

Data base

The data base shall be the knowledge of the manufacturers, wholesalers and retailers of the regulated products in Ireland as well as the knowledge of the production and sales data.

Therefore, the Environmental Protection Agency (EPA) started a data collection. Sources were the GoldenPages, Kompass and Homepages.

The selected information can be evaluated as a good data base of market actors for further monitoring.

The monitoring

The responsible authority is the Environmental Protection Agency (EPA). The inspectors lay down the inspections in reports and report the results of the monitoring to the EPA.

The staff was trained beforehand and the monitoring was piloted at a large retailer for examination of the process.

The administration and reporting issues seem to be clear and unambiguous and well planned. The piloting of the monitoring can be evaluated as good practice for a successful operational execution.

Due to the evaluated data base, the operators to be checked were chosen well considered to get a meaningful result, due to their relative size. The amount of samples to be taken was defined beforehand via a selection key; in total and for each product category.

The samples were taken on-site random by authority/sub-contractors staff. A beforehand defined amount of samples was taken for labelling and VOC content compliance check. The VOC content was analysed in accredited laboratories and with the test methods mentioned in the Directive, Annex III.

No check was scheduled for vehicle refinishing products in this monitoring period.

The monitoring seems to be effective, well prepared and with adequate administrative effort. The procedure can be recommended to other Member States. The monitoring programme announces a monitoring of vehicle refinishing products during the next monitoring period.

Evaluation summary

The monitoring concept is well structured and clearly described and can be considered an effective monitoring strategy.

Table 161: Evaluation of the monitoring programme of Ireland

Preparation	
Required data base	
Planned evaluation	Knowledge of manufacturers, wholesalers and retailers
Measures to build up the data base	Identification of potential relevant operators from sources such as GoldenPages, Kompass and web-sites etc. Following data entry verification. 1000 postal surveys and repeating phone calls. (a total of 325 operators where identified)
Monitoring	
Monitoring authorities/persons/institute	Environmental Protection Agency (EPA).
Reporting	A site inspection protocol has to be filled out for inspections with given questions to be answered. The inspection report has to be completed on site, dated and signed in the presence of the operator.

	One report (triplicate) to the EPA, one retained by contractor, one left with operator.
Monitoring subjects *Producers, importers, whole-salers, etc*	Manufacturers and retailers.
Monitoring objects *2004/42/EC:* *annex II.A: Subcategory a-l, each sb/wb = 24 subcategories* *annex II.B: Subcategory a-e, (a and c each x 2 subcategories) = 7 subcategories* *In total: 31 subcategories regulated by the Directive*	Products of all subcategories of paints and varnishes (not vehicle refinishing products in this monitoring period)
Monitoring content	
Monitoring content in general *2004/42/EC (Art. 3):* *MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II and comply with Art. 4 [labelling requirements]*	VOC content and labelling compliance verification
Labelling *2004/42/EC (Art. 4):* *(1) The subcategory of the product and the relevant VOC limit values in g/l as referred to in Appendix II.* *(2) The maximum content of VOC in g/l of the product in a ready to use condition*	Compliance with Art. 4 requirements
VOC content *2004/42/EC annex II A and B: (Art. 3) MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II […]*	Analytical tests of VOC content
Monitoring methods *2004/42/EC (Art. 6):* *MS shall set up a monitoring programme for the purpose of verifying compliance with this Directive*	
Monitoring intervals/allocation or random	Not described
Choice of monitored subject *Producers, importers, whole-salers, etc*	Chosen primarily on basis of relative size, to cover those with potentially highest sales volumes, many of which carry the same product lines nationally throughout their stores. “A number of large manufacturers and smaller retailers were also selected for inspection to attain a spread of operator activity levels.” [Monitoring programme IE, 2008] In total, 2 manufacturers and 25 retailers where inspected.
Choice of samples (in general)	Amount of inspections defined for every subcategory of paints and varnishes (in total 442 products targeted). Out of those, number of product inspections defined to be analytically analysed (in total 20 products targeted).
Monitoring of the labelling	

Sample taking for the checking of labelling	Detailed procedure not described. Out of overall description of monitoring, it can be assumed, that authority person takes the samples on site.
Verification of compliance with labelling requirements	Visual checks.
Monitoring of the VOC content	
Sample taking for the checking of VOC content	Detailed procedure not described. Out of overall description of monitoring, it can be assumed, that authority person takes the samples on site.
Verification of compliance with VOC content requirements	Analytical test methods.
Monitoring reports	A site inspection protocol has to be filled out for inspections with given questions to be answered. The inspection report has to be completed on site, dated and signed in the presence of the operator. Sampling protocol.
Technical Analysis	
Analytical methods *2004/42/EC (annex III):* *ISO 11890-2 VOC content* *ASTMD 2369 VOC content where reactive diluents are present* *[ISO 11890-1 (not mentioned in annex III]*	Test methods used as required in the Directive.
Consequences of non-compliance	
First measurement *2004/42/EC (Art. 10):* *MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].*	Not described.
After repeating non-compliance *2004/42/EC (Art. 10):* *MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].*	Not described.
Discretionary Decision	
Additional information	The inspection process was piloted before roll out of the monitoring in addition with training of the staff.

22.7. Monitoring programme of Lithuania

Data base

The required data base is not described, but a list of manufacturers and importers is available.

It is not exactly clear, on which kind of data base Lithuania acts (e.g. registration of market operators, research of the authority, etc). A list of manufacturers and importers is added to the monitoring programme, but completeness or the list or proportional size of the operators is not commented. This information could be added to the written monitoring programme.

The monitoring

The responsible authority is the State Non-Food Product Inspectorate under the Ministry of Economic Affairs. The inspectors lay down the inspections in reports according to the Aide-memoire on checking procedures.

The checks shall be executed at least once a year.

The administration and reporting issues are not described in detail. Those details could be added to the monitoring programme.

Due to the monitoring programme, all categories of paints and varnishes and vehicle refinishing products have to be checked. There is no written strategy how to achieve this goal. The amount of sample analysis necessary to get a significant result is not defined. However, it is stated that all category products placed on the market are to be checked.

It is not explicitly mentioned, but it can be assumed, that samples will be taken by authority officials themselves ("visual inspections" are required [Monitoring Programme LT, 2008]). For the sample taking procedure, it is referred to a national regulation (which is not at hand, resp. is presented in national language).

For the analytical, the test methods required in the Directive are stipulated.

The document describes the frame and content of the monitoring programme clear and unambiguous. Some more details could be added to the monitoring programme concerning the strategy and how the targets are planned to be met. Anyhow, those details may be written down in the national regulation (Rule).

Open questions

It is not evident from the document at hand, how sample taking is done and to which extent. It is not clear, which level of completeness of the data base is aimed at. It is not clearly defined, when analytical tests are to be carried out, it depends on consumers complaints or decisions during inspections.

Evaluation summary

The monitoring programme of Lithuania gives a clear and unambiguous picture of the monitoring targets and tackles all relevant issues, like which products shall be checked. Details of the strategy to meet those targets, like where and how many samples shall be taken and when analytical checks have to be accomplished, would complete the monitoring programme.

Table 162: Evaluation of the monitoring programme of Lithuania

Preparation	
Required data base	
Planned evaluation	Not defined.
Measures to build up the data base	Not defined.
Monitoring	
Monitoring authorities/persons/institute	State Non-Food Inspectorate, under the Ministry of Economic Affairs
Reporting	"Checks are to be recorded in accordance with the Aide-memoire on checking procedures" […] [Monitoring Programme LT, 2008]
Monitoring subjects *Producers, importers, wholesalers, etc*	Suppliers: Manufacturers and importers
Monitoring objects *2004/42/EC:* *annex II.A: Subcategory a-l, each sb/wb = 24 subcategories* *annex II.B: Subcategory a-e, (a and c each x 2 subcategories) = 7 subcategories* *In total: 31 subcategories regulated by the Directive*	All category products of paints and varnishes and refinishing products
Monitoring content	
Monitoring content in general *2004/42/EC (Art. 3):* *MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II and comply with Art. 4 [labelling requirements]*	VOC content and labelling compliance verification
Labelling *2004/42/EC (Art. 4):* *(1) The subcategory of the product and the relevant VOC limit values in g/l as referred to in Appendix II.* *(2) The maximum content of VOC in g/l of the product in a ready to use condition*	Compliance with Art. 4 requirements

VOC content *2004/42/EC annex II A and B: (Art. 3) MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II […]*	Analytical tests of VOC content
Monitoring methods *2004/42/EC (Art. 6):* *MS shall set up a monitoring programme for the purpose of verifying compliance with this Directive*	Not described in detail. Officials of the inspectorate are authorised to enter, without obstructions, the premises of any economic operator […], consult, free of charge, technical documentation […], obtain from manufacturers, importers , vendors and service providers […] test samples of products needed, […] [Monitoring Programme LT, 2008]
Monitoring intervals/allocation or random	At least once a year. “On the basis of facts that come to light, the head of a local branche office may decide on a different control frequency.” [Monitoring Programme LT, 2008]
Choice of monitored subject *Producers, importers, whole-salers, etc*	Not described.
Choice of samples (in general)	Not described.
Monitoring of the labelling	
Sample taking for the checking of labelling	Not described.
Verification of compliance with labelling requirements	Visual checks.
Monitoring of the VOC content	
Sample taking for the checking of VOC content	Product test samples are to be taken in accordance with Procedure: Official Gazette 2001, No. 80-2792. Product control samples are to be taken in accordance with standard LST EN ISO 15528:2003 (ISO 15528:2000) [Monitoring Programme LT, 2008]
Verification of compliance with VOC content requirements	Analytical test methods. Laboratory tests are to be carried out when necessary (consumer complaint, or decision during inspection).
Monitoring reports	“Checks are to be recorded in accordance with the Aide-memoire on checking procedures” […] [Monitoring Programme LT, 2008]
Technical Analysis	
Analytical methods *2004/42/EC (annex III):* *ISO 11890-2 VOC content* *ASTMD 2369 VOC content where reactive diluents are present* *[ISO 11890-1 (not mentioned in annex III]*	ISO 11890-2:2000

Consequences of non-compliance	
First measurement *2004/42/EC (Art. 10): MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].*	Penalty pursuant to Aricle 189(1) of the Administrative Infringement Code
After repeating non-compliance *2004/42/EC (Art. 10): MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].*	Not described.
Discretionary Decision	
Additional information	

22.8. Monitoring programme of the Netherlands

Data base

The data base is intended to reflect knowledge of the market concerning information about the operators, the paint products in shares and in total amounts, and about sales volumes and imports. An inventory of paint products is to be completed. Coverage of about 80-85% of the market was expected to be possible.

The data was gathered via trade associations and via internet.

The measures to gain the data base seem to be very effective.

The monitoring

The responsible authority is the Ministry of Housing, Spatial Planning and Environment. The executing entity is a consultant, COT.

Monitoring reports as well as inspection forms had to be set up, and a report had to be sent to the Ministry.

The administrative and reporting issues seem to be clear and unambiguous.

For the monitoring, it is planned to take a defined and significant number of samples per category and subcategory to check label and VOC content compliance. The choice of samples and operators to be checked is random.

Operators shall be called beforehand, except DIY builders merchants. Monitoring intervals are not mentioned. The sample taking process is not defined, but the text might be interpreted in that way that the inspectors take the samples.

The chemical analysis of the samples shall be done with the defined analysis methods.

The monitoring strategy is layed down in the monitoring programme; the strategy is intended to cover the main part of the Decopaint-market. The monitoring strategy is clear and comprehensive.

Open questions

It is not clear, who is taking the samples and how many operators are to be checked. It is not clear in which intervals the monitoring shall take place.

Evaluation summary

The monitoring programme is very recommendable. The strategy is completely layed down in written form.

Table 163: Evaluation of the monitoring programme of The Netherlands

Preparation	
Required data base	
Planned evaluation	Total amount of paints consumed in NL. Market share and data in tonnes of paints each for building, DIY and vehicle repair (these three segments about 83% of the market). Allocation of the data into three groups of market participants: [1] manufacturers/producers, [2] importers and wholesalers, [3] retailers and professional end-users (incl. vehicle repair).
Measures to build up the data base	Study by consultant (COT): Sources are trade associations and internet. The in that way compiled paints product inventory shall be adjusted later on with the operators.
Monitoring	
Monitoring authorities/persons/institute	Responsible Authority: Ministry of Housing, Spatial Planning and Environment. Executing entity: COT (Consultants)
Reporting	
Monitoring subjects *Producers, importers, wholesalers, etc*	[1] manufacturers, [2] importers/wholesalers and [3] retailers/professional end users shall be monitored in a ratio of 40:40:20.
Monitoring objects *2004/42/EC:* *annex II.A: Subcategory a-l, each sb/wb = 24 subcategories* *annex II.B: Subcategory a-e, (a and c each x 2 subcategories) = 7 subcategories* *In total: 31 subcategories regulated by the Directive*	24 subcategories for paints for buildings have to be monitored [12 subcategories, each for water born and solvent born], 7 subcategories for paints for vehicle refinishing = 31 subcategories

Monitoring content	
Monitoring content in general *2004/42/EC (Art. 3):* *MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II and comply with Art. 4 [labelling requirements]*	- Inspection of the labelling of paint cans covered by PD - Checking of whether the subcategory and max VOC content in g/l of product in ready-to-use form are stated on the product - collection of samples for laboratory analysis of VOC content
Labelling *2004/42/EC (Art. 4):* *(1) The subcategory of the product and the relevant VOC limit values in g/l as referred to in Appendix II.* *(2) The maximum content of VOC in g/l of the product in a ready to use condition*	
VOC content *2004/42/EC annex II A and B: (Art. 3) MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II […]*	
Monitoring methods *2004/42/EC (Art. 6):* *MS shall set up a monitoring programme for the purpose of verifying compliance with this Directive*	It was agreed, that 186 labels of different products have to be checked and out of these, 62 samples would be included for laboratory testing. The number of test products shall roughly correspond to the inventoried total number of products on the Dutch market, with a minimum of 3 and a maximum of 32. The same shall apply to the products to be analysed in laboratory, with a minimum of 2 and a maximum of 9. Particular attention shall be paid to VOC limit values [annex II] and labelling requirements [Art. 4].
Monitoring intervals/allocation or random	
Choice of monitored subject *Producers, importers, whole-salers, etc*	The choice of businesses visited is random. The businesses inspected had been called beforehand (exception: DIY).
Choice of samples (in general)	Within the subcategories, the sample is random. Provision: the smallest possible packs have to be chosen for laboratory.
Monitoring of the labelling	It was agreed, that 186 labels of different products have to be checked and out of these, 62 samples would be included for laboratory testing.
Sample taking for the checking of labelling	
Verification of compliance with labelling requirements	
Monitoring of the VOC content	It was agreed, that 186 labels of different products have to be checked and out of these, 62 samples would be included for laboratory testing.
Sample taking for the checking of VOC content	The businesses inspected had been called beforehand (exception: DIY). 65 paint samples have been checked in the COT laboratory (consultant).
Verification of compliance with VOC content requirements	Sample taking and analytical methods.
Monitoring reports	A monitoring protocol has been set up for the performance of the monitoring. It contains also instructions for product choices. A form has to be completed for each inspection (date, location, paint, etc).

Technical Analysis	
Analytical methods *2004/42/EC (annex III):* *ISO 11890-2 VOC content* *ASTMD 2369 VOC content where reactive diluents are present* *[ISO 11890-1 (not mentioned in annex III]*	ISO 11890-2 has been used or ASTMD 2369 [if reactive thinners are present in the paint, which applies to a single product]. In all samples, the VOC content also has been determined to ISO 11890-1. In the case of water-based paints, water content has been determined by the Karl Fisher method (ISO 760). To convert the VOC content from ISO 11890-1 (in percent by weight), to contents in gram per litre, the specific mass of the paint has been determined by the pyknometer method to ISO 2811-1.
Consequences of non-compliance	
First measurement *2004/42/EC (Art. 10):* *MS shall lay down the rules on penalties [...]. The penalties [...] must be effective, proportionate and dissuasive. [...].*	Not described.
After repeating non-compliance *2004/42/EC (Art. 10):* *MS shall lay down the rules on penalties [...]. The penalties [...] must be effective, proportionate and dissuasive. [...].*	Not described.
Discretionary Decision	
Additional information	

22.9. Monitoring programme of Portugal

The responsible authority (Agência Portuguesa do Ambiente (APA)) has delegated the preparation of a detailed monitoring programme to its executing authorities Inspecção Geral do Ambiente e do Ordenamento do Território (IGAOT) and Autoridade de Segurança Alimentar e Económica (ASAE).

Therewith, the analysed monitoring programme provides the general requirements made by APA to its executing authorities and not the detailed monitoring steps.

Data base

As basis for the monitoring, APA claims to establish a data base on products covered by the scope of the directive, comprising data on amounts, which have been produced, imported or sold in Portugal, separately listed by type of product. As APA delegates this challenge to other authorities, no procedures have been described to obtain this data base.

The requirements of the monitoring programme regarding the data base cover the entire scope of the Directive. Due to the deputation of responsibility, the suitability of procedures to set up the data base cannot be evaluated.

The monitoring

The responsibility for monitoring is split and allocated to the different authorities (IGAOT and ASAE). The monitoring shall cover producers, final consumers (vehicle finishing), importers, distributors and direct sale points, comprising products of all subcategories defined in Annex I and II.

The responsible authorities have to provide annually to the APA the monitoring results of the previous year.

The administration and reporting issues seem to be clear and unambiguous. From the consultant's point of view, a monitoring of final users is not necessary.

Concerning the monitoring content, the authorities shall provide information to APA concerning the "characteristics of the label" by type of products and information of the VOC content, "where possible by means of results of analysis"

Subject to the possibility of more detailed instructions to the monitoring authorities by the APA, those instructions of the compliance check of VOC content could be layed down more clearly. The compliance check should not only take place "where possible" but due to a pre-planned strategy.

The monitoring methods are not defined. The monitoring authorities are advised to take a "representative number of samples every year", which should be distributed geographically on the basis of various agents involved, to be decided jointly by the monitoring authorities.

The "representative number" should be defined in the monitoring programme. In case that no more detailed instructions are given to the monitoring authorities by the APA, the monitoring programme should be more clearly at this point.

In the document at hand, there are no guidelines given how labels have to be checked or how samples have to be taken.

Further more it is stated, that the VOC content shall be analysed "from time to time, where possible". A method to verify the VOC content is not required.

Concretion of definitions or expressions like "products placed on the market", "from time to time" or " where/when possible" and therewith indications for the executing authorities, when and how products should efficiently be checked, are not given in the document at hand.

The sent in document does lay down the general requirements of the monitoring programme. It can be assumed, that more detailed instructions for the monitoring are given to the authorities by the APA. Those (not present) detailed instructions combined with this document would compile an appropriate monitoring programme.

Open questions

It is not known, which more detailed informations are given to the executing authorities concerning the strategy of monitoring.

Evaluation summary

The quality and capability of the monitoring programme can not be evaluated extensively, as the detailed monitoring strategy is not available. For a clear and unambiguous monitoring programme, it is proposed to implement the detailed instructions of APA to the executing authorities into the document at hand.

Table 164: Evaluation of the monitoring programme of Portugal

Preparation	
Required data base	
Planned evaluation	On producers: List of manufactured products (and quantities) covered by the Decree-Law No 181/2006. Information on the quantities sold each year by type of product. On importers: List of imported products covered by the Decree-Law and quantities thereof. Information on the quantities sold each year by type of product.
Measures to build up the data base	On producers: Order to IGAOT to provide the data. On importers: Order to ASAE to provide the data.
Monitoring	
Monitoring authorities/persons/institute	Responsible: Agência Portuguesa do Ambiente (APA) Executive: Inspecção-Geral do Ambiente e do Ordenamento do Território (IGAOT), Autoridade de Segurança Alimentar e Económica (ASAE). IGAOT - checks on producers and final consumers (vehicle finishing) ASAE - checks on importers, distributors and direct sale points
Reporting	The relevant agents (IGAOT and ASAE) have to submit each year (by 31 March) information of monitoring of the previous year to APA each year.
Monitoring subjects *Producers, importers, whole-salers, etc*	Producers, final consumers (vehicle finishing), importers, distributors, direct sale points
Monitoring objects *2004/42/EC:* *annex II.A: Subcategory a-l, each sb/wb = 24 subcategories* *annex II.B: Subcategory a-e, (a and c each x 2 subcategories) = 7 subcategories* *In total: 31 subcategories regulated by the Directive*	All products covered by the Decree-Law.
Monitoring content	

Monitoring content in general *2004/42/EC (Art. 3):* *MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II and comply with Art. 4 [labelling requirements]*	Information on the label by type of product shall be provided to APA (only in the first year, in subsequent years only if changes have occurred. For producers: The criteria used for classifying a specific product under the category
Labelling *2004/42/EC (Art. 4):* *(1) The subcategory of the product and the relevant VOC limit values in g/l as referred to in Appendix II.* *(2) The maximum content of VOC in g/l of the product in a ready to use condition*	For producers and importers: The characteristics of the label of the products
VOC content *2004/42/EC annex II A and B: (Art. 3) MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II […]*	For producers: VOC content, where possible by means of results of analysis.
Monitoring methods *2004/42/EC (Art. 6):* *MS shall set up a monitoring programme for the purpose of verifying compliance with this Directive*	
Monitoring intervals/allocation or random	Each year by 31 March, the monitoring authorities shall provide to APA the information collected by each of them in checks carried out. The checks shall be carried out on the basis of a representative sample of the national situation of producers/importers of the products covered, distributed over five administrative regions (Norte, Centro, Lisboa Vale do Tejo, Alentejo and Algarve).
Choice of monitored subject *Producers, importers, wholesalers, etc*	
Choice of samples (in general)	Representative number of samples every year, distributed geographically on the basis of various agents involved, to be decided jointly by the monitoring authorities.
Monitoring of the labelling	
Sample taking for the checking of labelling	
Verification of compliance with labelling requirements	
Monitoring of the VOC content	From time to time, where possible, the monitoring authorities (IGAOT and ASAE) shall carry out analysis of the VOC content.
Sample taking for the checking of VOC content	
Verification of compliance with VOC content requirements	
Monitoring reports	
Technical Analysis	

Analytical methods *2004/42/EC (annex III):* *ISO 11890-2 VOC content* *ASTMD 2369 VOC content where reactive diluents are present* *[ISO 11890-1 (not mentioned in annex III]*	
Consequences of non-compliance	
First measurement *2004/42/EC (Art. 10):* *MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].*	
After repeating non-compliance *2004/42/EC (Art. 10):* *MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].*	
Discretionary Decision	"from time to time, where possible" analysis of VOC content shall be carried out "representative number of samples"
Additional information	

22.10. Monitoring programme of Romania

Data base

The required data base is not exactly described, but Romania addresses economic agents in general. The measurement to build up the data base is not described. The monitoring programme contains a list of economic agents.

It is not clear, on which kind of data base Romania acts but a data base seems to be available and the requirements for quality of this data base seem to be taken into account. It could be added to the monitoring programme, how economic agents in this coherence are defined.

The monitoring

The responsible authority is the Ministry of Environment and Sustainable Development. The inspectors report the results of the monitoring.

For the inspections, there are prepared an Inspector Guide and lists to fill in the result of the monitoring with all categories and subcategories listed. The different actions of monitoring are described in a flow chart.

As for the frequency of the inspections, there are different types: visit, annual systematic inspection, re-inspection, etc.

> The administration and reporting issues are not described in detail, but seem to be complete. The documents, lists, flowcharts and templates prepared are a good guideline for the monitoring persons. The prepared guidelines and templates can be recommended to other Member States.

The economic agents to be monitored shall be evaluated on the criteria of size, main activity, etc. and products shall be compliance checked concerning labelling, VOC content and other issues like orderly documentation or special risks assignation. The market actors usually shall be informed about the visit beforehand, unless checks shall take place randomly. In case of non-compliance, further monitoring and reassessment takes place.

The choice of the product samples and the amount of the checks are not further described. The labels have to comply with the requirements of the Directive and shall follow the recommended format. The VOC content shall be checked with the required analytical methods.

> The monitoring strategy is clear and tackles all relevant issues. The administrative background, like guidances for the inspectors, information of manufacturers and inspectors of legal background etc, is very detailed. Concerning choice of monitored market actor or sample taking, relevant criteria like size of manufacturer and therewith linked amount of samples to be taken are mentioned. The details of broken down figures, however, e.g. like how many samples have to be taken, could be added to the monitoring programme.

Open questions

The definition of economic agent is not exactly clear.

It is clear, that operators to be checked are chosen by special criteria, but it is not clear, which criterion leads to the "nomination". The same is true for samples to be taken. It is not clear, how many samples have to be taken at which market actor (e.g. allocation key) and how many of them and which ones are to be compliance checked for maximum VOC content.

Evaluation summary

The monitoring programme of Romania is very structured and gives very good guidelines for the inspectors. Some statistical details could be added, like an allocation key for sample taking or selection of market actors to be monitored.

Table 165: Evaluation of the monitoring programme of Romania

Preparation	
Required data base	
Planned evaluation	Not defined. A list of economic agents is added to the monitoring programme.
Measures to build up the data base	Not described.

Monitoring	
Monitoring authorities/persons/institute	Ministry of Environment and Sustainable Development
Reporting	An Inspection Report shall be submitted within five days from finalizing the inspection
Monitoring subjects *Producers, importers, wholesalers, etc*	Economic Agents, involved in the manufacture, importation, distribution and professional end-use of paints, varnishes and vehicle refinishing products
Monitoring objects *2004/42/EC:* *annex II.A: Subcategory a-l, each sb/wb = 24 subcategories* *annex II.B: Subcategory a-e, (a and c each x 2 subcategories) = 7 subcategories* *In total: 31 subcategories regulated by the Directive*	"Each paint, varnish and vehicle refinishing product, manufactured or imported"
Monitoring content	
Monitoring content in general *2004/42/EC (Art. 3):* *MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II and comply with Art. 4 [labelling requirements]*	VOC content and labelling compliance verification
Labelling *2004/42/EC (Art. 4):* *(1) The subcategory of the product and the relevant VOC limit values in g/l as referred to in Appendix II.* *(2) The maximum content of VOC in g/l of the product in a ready to use condition*	Compliance with Art. 4 requirements, and/or compliance with the recommended uniform format for the labelling
VOC content *2004/42/EC annex II A and B: (Art. 3) MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II […]*	Analytical tests of VOC content
Monitoring methods *2004/42/EC (Art. 6):* *MS shall set up a monitoring programme for the purpose of verifying compliance with this Directive*	Visit of authority persons, verification of the products with standards, sample taking. Random verification is possible as well as written messages to the operator before the visit.
Monitoring intervals/allocation or random	Different types of inspection: visit, annual systematic inspection, re-inspection, etc
Choice of monitored subject *Producers, importers, wholesalers, etc*	The economic agents who shall be monitored are to be selected due to the criteria of their activities field, size and due to specific information. *The concrete criteria are not described.*
Choice of samples (in general)	Not described.

Monitoring of the labelling	
Sample taking for the checking of labelling	Not described.
Verification of compliance with labelling requirements	Not described in detail, assumed due to overall description of monitoring process: visual checks on-site. The labels have to comply to the Directives requirements and should follow the recommended format, which is layed down in the "Inspectors Guide"
Monitoring of the VOC content	
Sample taking for the checking of VOC content	Not described.
Verification of compliance with VOC content requirements	Analytical test methods.
Monitoring reports	An Inspection Report shall be submitted within five days from finalizing the inspection
Technical Analysis	
Analytical methods *2004/42/EC (annex III):* *ISO 11890-2 VOC content* *ASTMD 2369 VOC content where reactive diluents are present* *[ISO 11890-1 (not mentioned in annex III]*	ISO 11890-2, ASTMD 2369
Consequences of non-compliance	
First measurement *2004/42/EC (Art. 10):* *MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].*	Communicate the infringements to the operator. Penalties according to the provisions of Emergency Ordinance no 2/2001 Further monitoring of the agent. Evaluation of the measures, the economic agent taken to be in compliance. Reassessment of the agent.
After repeating non-compliance *2004/42/EC (Art. 10):* *MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].*	Not described.
Discretionary Decision	
Additional information	

22.11. Monitoring programme of Slovakia

Data base

The data base for the monitoring is not defined. Slovakia refers to the "regulated products" in general, without further description of how to evaluate the quantity and quality.

The definition of the underlying data base is abstract. Concrete measures to build up the data base are not described. The monitoring programme could be improved by giving more details of the data gathering strategy in written form.

The monitoring

The responsible authority for the monitoring is the Ambient Air Protection Department of the Central Office of the Slovak Environment Inspectorate. The inspection is carried out by its regional offices (for producers and importers) and by a Commercial Inspectorate (SOI) which is usually in charge of monitoring issues (retail and wholesale). The reporting is reunited central at the Environment Inspectorate.

The allocation of monitoring subjects to different authorities seems to be an effectual measurement to cover the whole market. If no clear targets are provided by a central authority, it could happen that the administrative strength of the good allocation will not be carried into effect.

The monitoring content is to check compliance with the regulated VOC content and labelling requirements in general as well as to ensure record-keeping on regulated products sold. The focus shall as well be layed on the monitoring of products that do not comply with the requirements of the Directive due to exceptional rule (products dedicated for the use of restoration of buildings or vehicles). There is no further detail layed down who has to be monitored, by when or in which way and extent.

Subject to the possibility of more detailed instructions to the monitoring authorities by the Environment Inspectorate, those detailed strategy plannings are missing in the document at hand and could be layed down in written form to complete the monitoring programme.

The monitoring methods are not defined. There is no description of which quantity of samples has to be taken and in which way or extent they have to be taken.

The information of the quantity of samples taken and the strategic plan, where to take the samples and which part of the market shall be covered by the sample taking is missing in the document at hand. The strategic plannings of the monitoring methods should be added to the document to complete the monitoring programme.

Open questions

It is not clear, whether the executing authorities received more detailed instructions to execute the monitoring or have to elaborate on details.

Evaluation summary

The present monitoring programme covers all relevant issues. However, it does not provide details of the concrete strategy. There are no targets described concerning the quantity of inspections or the amount and allocation of sample taking. Those details should be planned beforehand and added to the document to complete the monitoring programme.

Table 166: Evaluation of the monitoring programme of Slovakia

Preparation	
Required data base	
Planned evaluation	Not described.
Measures to build up the data base	Not described.
Monitoring	
Monitoring authorities/persons/institute	Coordination, giudance and assessment of the performance: Ambient Air Protection Department ot the Central Office of the Slovak Environment Inspectorate. Inspections on producers/importers: Environment Inspectorate's regional ambient air protection departments (in Bratislava, Žilina, Banská Bystrica and Košice) Inspection retail/wholesale: Slovak Commercial Inspectiorate (SOI), which informs Environment Inspectorate
Reporting	SOI provide the information to the Environment Inspectorate about monitoring inspections. A list of traders authorised to use non-complient products due to restore monuments and vintage vehicles is submitted to Environment Inspectorate by district environment offices.
Monitoring subjects *Producers, importers, wholesalers, etc*	Producers and importers of regulated products. Retail and wholesale network.
Monitoring objects *2004/42/EC:* *annex II.A: Subcategory a-I, each sb/wb = 24 subcategories* *annex II.B: Subcategory a-e, (a and c each x 2 subcategories) = 7 subcategories* *In total: 31 subcategories regulated by the Directive*	Regulated products in general.
Monitoring content	
Monitoring content in general *2004/42/EC (Art. 3):* *MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II and comply with Art. 4 [labelling requirements]*	Monitoring specifies inspection location and entities inspected (importers and producers of regulated product). Ensure compliance with national ceilings laid down in Directive 2001/81/EC. Establish current situation regarding production of regulated products in Slovakia and the importation of these products, the tendencies and trends. Checking that the Inspectorate is provided with data according to article 18(8) of Ambient Air Act

Labelling *2004/42/EC (Art. 4):* *(1) The subcategory of the product and the relevant VOC limit values in g/l as referred to in Appendix II.* *(2) The maximum content of VOC in g/l of the product in a ready to use condition*	Checking compliance of the labelling.
VOC content *2004/42/EC annex II A and B: (Art. 3) MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II […]*	Taking samples to be analysed in accredited laboratory. Establishing the VOC content of the coatings using analysis methods (Environment Ministry Decree No 133/266).
Monitoring methods *2004/42/EC (Art. 6):* *MS shall set up a monitoring programme for the purpose of verifying compliance with this Directive*	"will carry out checks on traders who produce or import the regulated products" [Monitoring programme PT, 2008] "checks will focus on record-keeping on the quantity and quality of regulated products sold […]" [and the exceptions due to restoration operations] [Monitoring programme PT, 2008]
Monitoring intervals/allocation or random	Not described.
Choice of monitored subject *Producers, importers, whole-salers, etc*	Not described.
Choice of samples (in general)	Not described.
Monitoring of the labelling	Not described.
Sample taking for the checking of labelling	Not described.
Verification of compliance with labelling requirements	Not described.
Monitoring of the VOC content	Not described.
Sample taking for the checking of VOC content	Not described.
Verification of compliance with VOC content requirements	Not described.
Monitoring reports	Five reports shall report the monitoring results: they contain number of entities established and inspected quantity of regulated products produced by category and subcategory, each for producers and importers. Results of monitoring concerning compliance with labelling and VOC content. Fines imposed for non-compliance. Exceptions granted for reconstruction of buildings and repairs on vintage vehicles.
Technical Analysis	
Analytical methods *2004/42/EC (annex III):* *ISO 11890-2 VOC content* *ASTMD 2369 VOC content where reactive diluents are present* *[ISO 11890-1 (not mentioned in annex III]*	annex 3 of Environment Ministry Decree No 13/266

Consequences of non-compliance	
First measurement *2004/42/EC (Art. 10): MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].*	Fine of trader or importer in case of non-compliance with mandatory requirements of VOC content or labelling.
After repeating non-compliance *2004/42/EC (Art. 10): MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].*	
Discretionary Decision	
Additional information	

22.12. Monitoring programme of Slovenia

Slovenia has set up Rules on operational monitoring for the VOC content in paints, varnishes and vehicle refinishing products. Those Rules give the frame for the monitoring programmes, which have to be drawn up for each individual year by the Agency of the Republic of Slovenia (Agency).

Data base

The data base for the monitoring shall be based on complete knowledge of products covered by the Directive by category and amount, which are produced and sold in the Member State - separately described by type and subcategory of the product.

In Slovenia, an environmental tax has to be paid for environmental pollution due to the use of VOC. Thus, the producer, acquirer and importer of the products covered by the Directive are known. Those market actors have to provide information on type and quantity of their products as well as names and addresses of traders placing the products on the market.

The requirements of monitoring programme for the data base cover the Directives' scope all-embracing. The measures to achieve this aim seem to be very valuable.

The monitoring

The responsible authority is the Agency of the Republic of Slovenia. The authority selects the implementers for the monitoring of the coming year on basis of a public call for participation.

The responsible authorities have to provide the relevant information of the monitoring of the previous year annually to the APA.

The administration and reporting issues seem to be clear and unambiguous.

The method for the compliance check of the VOC content of the products is clearly described. The quantity and amount of samples that have to be taken (differentiated by the group of paints and varnishes and of vehicle refinishing products) by the implementer of the monitoring has to be calculated by a special calculation key. The locations, where the samples have to be taken (inside of the installations production or stock) are defined as well as the time frame the samples have to be taken within. The VOC content will be analysed in accredited laboratories and with the test methods mentioned in the Directive, Annex III. The samples are taken by the responsible person of the assigned implementer.

As monitoring content and execution, the compliance check of the labelling is not separately mentioned.

The rules for the monitoring and for the monitoring methods are described very detailed. Especially the calculation key for the amount of sample taking is very exactly. As far as details of the monitoring are not specified, the Rules clearly state that and indicate how these details are to be specified by the implementers who are annually announced. These Rules fully meet the requirements of a written monitoring programme.

Open questions

The focus of the compliance check seems to lie on the VOC content of the products. It is not entirely clear, whether or how Slovenia integrates a compliance check for the labelling.

Evaluation summary

The Rules for the monitoring programme and the monitoring strategy is well planned, easy to understand and is very recommendable. The compliance check of the labelling could be pointed out more clearly.

Table 167: Evaluation of the monitoring programme of Slovenia

Preparation	
Required data base	
Planned evaluation	Knowledge of annual quantity of products (covered by the Directive) produced and sold.
Measures to build up the data base	Manufacturers, importers and acquirers (called liable person) shall report their production or selling data as well as the addresses of the traders that place those products on the market. As in Slovenia there is environmental tax to be paid for those who manufacture VOC, those companies and persons are known.
Monitoring	
Monitoring authori-	Responsible for the monitoring Agency of the Republic of Slovenia.

ties/persons/institute	Implementers of the Monitoring Programme (executive entity) will be selected by the Agency each year on the basis of public call.
Reporting	The implementers shall annually report to the Agency the implementation of the monitoring programme on the basis of the data in the reports of the liable persons. The report shall contain a summary of data of the annual monitoring programme (list of places, where samples of products were taken, with breakdown by liable person, group and subcategory of product, and an assessment of the compliance)
Monitoring subjects *Producers, importers, wholesalers, etc*	Producers, acquirers and importers of products which, in the previous year, paid environmental tax for environmental pollution due to the use of VOC.
Monitoring objects *2004/42/EC:* *annex II.A: Subcategory a-l, each sb/wb = 24 subcategories* *annex II.B: Subcategory a-e, (a and c each x 2 subcategories) = 7 subcategories* *In total: 31 subcategories regulated by the Directive*	All products covered by the Directive.
Monitoring content	
Monitoring content in general *2004/42/EC (Art. 3):* *MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II and comply with Art. 4 [labelling requirements]*	As part of the monitoring programme: measurement of the content of VOC, check that the samples taken meet the requirements of the provision on limit values.
Labelling *2004/42/EC (Art. 4):* *(1) The subcategory of the product and the relevant VOC limit values in g/l as referred to in Appendix II.* *(2) The maximum content of VOC in g/l of the product in a ready to use condition*	Not described.
VOC content *2004/42/EC annex II A and B: (Art. 3) MS shall ensure that products set out in annex I […] have a VOC content not exceeding the limit values set out in annex II […]*	Measure the VOC content.
Monitoring methods *2004/42/EC (Art. 6):* *MS shall set up a monitoring programme for the purpose of verifying compliance with this Directive*	
Monitoring intervals/allocation or random	Monitoring shall take place annually at each liable person
Choice of monitored subject *Producers, importers, wholesalers, etc*	Not explained, but: The rules for the monitoring explain how to define the quantity of samples that shall be determined for "each liable person". Liable person is everybody, who paid environmental tax the previous year. Therefore it seems that every liable person has to be checked.

Choice of samples (in general)	The quantity of samples shall be determined separately per group of paints. The quantity shall be determined as well for each liable person and for individual group of products on the basis of a special calculation, depending on the production or sales volume.
Monitoring of the labelling	Not described.
Sample taking for the checking of labelling	Not described.
Verification of compliance with labelling requirements	Not described.
Monitoring of the VOC content	Not described.
Sample taking for the checking of VOC content	The quantity of samples per liable person has to be calculated. Depending on the total quantity, the samples have to be taken at different places of the production or storage and of as much varying product groups as possible. Samples have to be taken: Producers – at the place of production Importers and Acquirers – at the place of storage Traders – at the place of placing on the market for final users The implementers "shall perform the operation" of sample taking. The samples have to be taken within a time frame, which has to be named and from different places inside the entity. If due to the production amount of a liable person's installation, more quantities of product samples have to be taken than different sampling locations exist (production area, storing areas, etc), the remaining quantities of samples have to be taken at the different places at the premises of the traders, apart from the producer of the products. Per product sample, at least 1 litre has to be taken, for vehicle refinishing products, at least 0.5 litres.
Verification of compliance with VOC content requirements	The samples are to be checked via the required analytical methods.
Monitoring reports	An overall annual report of the monitoring, the implementing and the assessment of the compliance of the content of the VOC has to be provided to the Agency. The report contains the places of sample taking, broken down by liable person and by group and subcategory of products within an individual group of products.
Technical Analysis	
Analytical methods *2004/42/EC (annex III):* *ISO 11890-2 VOC content* *ASTMD 2369 VOC content where reactive diluents are present* *[ISO 11890-1 (not mentioned in annex III]*	The analytical methods required by the Directive have to be used.
Consequences of non-compliance	
First measurement *2004/42/EC (Art. 10):* *MS shall lay down the rules on penalties […]. The penalties […] must be effective, propor-*	Not described.

tionate and dissuasive. […].	
After repeating non-compliance *2004/42/EC (Art. 10):* *MS shall lay down the rules on penalties […]. The penalties […] must be effective, proportionate and dissuasive. […].*	Not described.
Discretionary Decision	
Additional information	The liable persons shall bear the costs the implementer incurs due to the implementation of the monitoring programme.
	The reliable person has to agree implementation (Art. 5 of Rule of monitoring), inform the implementer of the places and time of sample taking and of name and addresses of the persons, responsible for handing over the samples of products at the place of production or storage, etc

Annex 23 Monitoring programme

23. Proposal for 3 levels of ambition for a monitoring programme

The effectiveness of the monitoring programme and the representativeness of the monitoring results rely on a combination of measurements and decisions. Those are:

- the choice of the subjects to be checked in general (manufactuers, wholesalers, importers, DIY´s)
- the decision of how many entities of each group shall be monitored
- the decision of how many units of each category shall be checked (how many out of a total, out of a group, out of a monitored company)
- the selection of the monitoring content to be checked (categories defined in the Directive 42/2004/EC)
- the decision on how the samples are taken and by whom
- the procedure how compliance with labelling requirements and VOC content is verified

The measurements described below in one column are to be understood in combination with each other to build up one monitoring programme.

	Minimum Monitoring Programme	Good Practice Monitoring Programme	Best Practice Monitoring Programme
1. Preparation			
1.1 Data base coverage The quality of the data base is significantly influence the quality of the monitoring programme.	Based on knowledge of the total national sales of products under the scope of Directive 2004/42/EC (see 1.2), for a minimum monitoring programme it is recommended to build up a data base covering the majority of annual national production and import amounts. If this condition is fulfilled by one single company (manufacturer or importer), at least two addition major companies shall be taken up in the data base. As for wholesalers and DIY, at a minimum two leading companies of each shall be taken up in the data base.	Based on knowledge of the total national sales of products under the scope of Directive 2004/42/EC (see 1.2), for a good practice monitoring programme it is recommended to build up a data base covering more than 80 % of the approximate annual national production and import amounts of each product category of Directive 2004/42/EC. As for wholesalers and DIY, at least all national-wide operating companies of each shall be taken up in the data base. Additionally about 10 – 15 small stores from different areas shall be taken up in the data base.	Based on knowledge of the total national sales of products under the scope of Directive 2004/42/EC (see 1.2), for a good practice monitoring programme it is recommended to build up a data base covering more than 80 % of the approximate annual national sales amounts of each product category of Directive 2004/42/EC. As for wholesalers and DIY, about 80 % of the companies of each shall be taken up in the data base. Additionally about 20 – 30 small stores from different areas shall be taken up in the data base.
1.2 Measures to build up the data base	Measures to build up the data base: - Contact national paint producers associations - Contact national wholesalers associations - Contact authorities responsible for registering and monitoring paint manufacturing activities under the national regulation implementing the SED Directive (1999/13/EC)	Measures to build up the data base: - Contact national paint producers associations - Contact national wholesalers associations - Contact authorities responsible for registering and monitoring paint manufacturing activities under the national regulation implementing the SED Directive (1999/13/EC) - Research via internet and commercial telephone books, verifying entries by personal communication	Measures to build up the data base: - Contact national paint producers associations - Contact national wholesalers associations - Contact authorities responsible for registering and monitoring paint manufacturing activities under the national regulation implementing the SED Directive (1999/13/EC) - Research via internet and commercial telephone books, verifying entries by personal communication - Implement national regulations obligat-

	Minimum Monitoring Programme	Good Practice Monitoring Programme	Best Practice Monitoring Programme
			ing registration at national authorities of manufacturers and importers when placing on the market products under Directive 2004/42/EC, providing contact details, product categories and national sales amounts and VOC contents separately for each product category.
2. General recommendations			
2.1 Documentation	The monitoring programme shall be layed down in a written form. Unclear expressions shall be avoided (e.g. "from time to time", "where necessary") or shall be clearly defined.		
2.2 Monitoring institutions	The monitoring programme shall define the institutions (centralised or in different regions) and related persons responsible for • definition of the monitoring programme • execution of the monitoring • evaluation of effectiveness of the monitoring. Especially in case of shared or deputed responsibilities, the tasks of each institution should be clearly documented and communicated.		
2.3Reporting content	The reporting content, the reporting periods and the addressed institutions (with contact details) shall be clearly defined (what to be reported by when from which person to whom).		
2.4 Monitoring subjects *Producers, importers, wholesalers, etc*	The Directive regulates "placing on the market" of products under the scope. Therefore, subjects to be monitored should be "interfaces" to the market like manufacturers, importers, wholesalers and DIY (Do-it-yourself) stores. The monitoring of endusers can give indications for wrong use of non-compliant products (applied to objects under the scope of the directive), but not for wrong placing on the market.		
	In summary it is to be stated, that in general all of the monitoring subjects (manufacturers, importers, wholesalers, DIY´s) shall be monitored. Depending on the available resources of the responsible authority, not all types of monitoring subjects have to be	In summary it has to be stated, that in general all of the monitoring subjects (manufacturers, importers, wholesalers, DIY´s) shall be monitored. Depending on the available resources of the responsible authority, not all of the monitoring subjects have to be monitored in the same monitoring period. As good and best standard requirement, the combination of monitoring subjects chosen in a monitoring period should ensure a total market penetration in terms of: statistically all possible market actors (manufacturers / importers) should be	

	Minimum Monitoring Programme	Good Practice Monitoring Programme	Best Practice Monitoring Programme
	monitored in the same monitoring period. A rotating system could be installed to cover all monitoring subjects, covering all types of monitoring subjects after several years. Criterion for the application of a rotating monitoring system: - it has to be ensured, that in every monitoring period a majority of the market (national sales amounts) is monitored.	monitored. This means, e.g. the combination of monitoring manufacturers and wholesalers/ importers at the same monitoring period, could cover the main part of the national market of products under Directive 2004/42/EC (min. 90%) in terms of: statistically all product categories are available out of all possible sources. The same could be assumed for the combination e.g. of monitoring of DIY´s (e.g. focussing on imported products) and manufacturers. Criterion for the the choice of combination of monitoring subjects - the combination of monitoring subjects all together should be able to cover all product categories defined in Directive 2004/42/EC out of all possible product sources (products manufactured nationally and products imported from inside and outside the EU) If the combination of a few monitoring subjects does not ensure a total market penetration (maybe due to uncomplete data base of market actors), market actors out of all monitoring subjects shall be monitored.	
2.5 Monitoring objects *2004/42/EC:* *Annex II.A: Subcategory a-l, each sb/wb = 24 subcategories* *Annex II.B: Subcategory a-e, (a and c each x 2 subcategories) = 7 subcategories* *In total: 31 subcategories regulated by the Directive*	In generall, exemplary products of all product categories defined in Directive 2004/42/EC should be monitored. Depending on the available resources of the responsible authority, not all product categories may be monitored in the same monitoring period. I could be decided for a rotating system, which monitores Annex II, A. products (paints and varnishes) and Annex II, B. products (vehicle refinishing products) in terms. The product categories with the highest VOC content should always be subject of monitoring.	Exemplary products of all product categories defined in Directive 2004/42/EC, Annex II A. (paints and varnishes) and Annex II B. (vehicle refinishing) are to be monitored.	

	Minimum Monitoring Programme	Good Practice Monitoring Programme	Best Practice Monitoring Programme
2.6 Combination of monitoring subjects and monitoring objects	Independently of which monitoring subjects and monitoring objects shall be monitored in the current monitoring period, it has to be ensured, that either a representative number of monitoring subjects (producers, importers, wholesalers, DIYs) or the whole range of categories of Decopaint products by the monitoring. It is not recommended to monitor in one period only one monitoring subject and one product category, e.g.: monitoring of vehicle refinishing paints at importers only. At a rotational monitoring system of subjects (e.g. either manufacturers only or wholesalers only) it shall be ensured, that in every monitoring period a representative part of the national sales/market is covered. If in one monitoring period e.g. DIY´s are to be monitored, it has to be ensured, that - a representative number of stores, spread over different store brands, are covered by the monitoring - that samples are taken from various product categories in each monitored store, - that in total various samples of every product category are taken - that in every product category products of different manufacturers are taken - that in every product category import products are taken (if existing) At a rotational monitoring system of objects (e.g. either decorative paints or vehicle refinishing paints) it shall be ensured, that in every monitoring period a representative part of monitoring objects is monitored. If in one monitoring period e.g. vehicle refinishing paints are to be monitored, it has to be ensured, that - a representative number of manufacturers and importers (EU-country imports and non-EU-country imports) are monitored - that samples are taken from all vehicle refinishing categories in every monitored subject - that in every category products of different manufacturers/importers are taken		The combination of a monitoring of all monitoring subjects (resp. a combination of monitoring subjects that lead to the coverage of products of all market actors) and the monitoring of all product categories defined in Directive 2004/42/EC can lead to ideal monitoring results.

	Minimum Monitoring Programme	Good Practice Monitoring Programme	Best Practice Monitoring Programme
3. Monitoring			
3.1 Monitoring content *2004/42/EC (Art. 3):* *MS shall ensure that products set out in Annex I […] have a VOC content not exceeding the limit values set out in Annex II and comply with Art. 4* *2004/42/EC (Art. 4):* *(1) The subcategory of the product and the relevant VOC limit values in g/l as referred to in Appendix II.* *(2) The maximum content of VOC in g/l of the product in a ready to use condition*	As required in the Directive, the correct labelling of the defined products has to be checked as well as the compliance with the maximum VOC content of the product category. To fullfill the monitoring requirements, both requirements have to be checked.		
3.2 Monitoring methods *2004/42/EC (Art. 6):* *MS shall set up a monitoring programme for the purpose of verifying compliance with this Directive*	The monitoring procedure and the monitoring methods shall be documented and distributed to the responsible institutions/persons at least 6 month before the start of the monitoring period.		
3.3 Monitoring intervalls/allocation or random	If the minimum requirements concerning e.g. data base coverage, selection of monitoring subjects and objects and number of samples are fulfilled, the monitoring should be each year or every second year (and in correspondence with Art. 7 of Directive 2004/42/EC). The monitoring intervals should be defined in the monitoring programme.	If fulfilling good or best standard requirements concerning e.g. data base (expecially in interaction with possibly existing register-obligations), choice of monitoring subjects and objects or sample taking, the monitoring intervals could be within two to five years (and in correspondence with Art. 7 of Directive 2004/42/EC). The monitoring intervalls should be documented in the monitoring programme.	

	Minimum Monitoring Programme	Good Practice Monitoring Programme	Best Practice Monitoring Programme
3.4 Choice of monitored subject *Producers, importers, wholesalers, etc*	On basis of the allocated data base, it shall be decided and documented beforehand, which kind of monitoring subject and how many of them shall be monitored and how these subjects shall be selected. In a rotational monitoring system it shall be ensured, that a representative share of the monitoring subjects active on the market are covered by the monitoring. If e.g. manufacturers shall be monitored in the actual monitoring period, it could be decided e.g. to monitor all those manufacturers which in sum hold a market share of 60%-70% of products covered by Directive 2004/42/EC. If e.g. DIY´s shall be monitored in the actual monitoring period, the decision could be to monitor brands of DIY´s holding a market share of 60% and thereof check e.g. 10 stores each and additionally check at least 15 smaller / individuall DIY´s. Such a decision depends on the market structure of the individual Member State and shall ensure a representative and effective monitoring.	On basis of the data base, it shall be decided and documented beforehand about the kind of monitoring subject, the number of monitored companies and the way of selection. When monitoring subjects are combined, they shall be chosen to ideally complement each other and cover the whole market of products unter Directive 2004/42/EC. If e.g. manufacturers and wholesalers are monitored, especially products of importers shall be monitored at wholesalers (as products of national producers would be covered by monitoring of manufacturers). Such a planned selection of monitored subjects requires an up-to-date data base and a good knowledge of the market.	

<table>
<tr><th></th><th>Minimum Monitoring Programme</th><th>Good Practice Monitoring Programme</th><th>Best Practice Monitoring Programme</th></tr>
<tr><td rowspan="2">3.5 Selection of samples</td><td colspan="3">A sampling system shall be defined beforehand, defining how selection of samples shall take place and which number and amount of samples shall be taken. The sampling strategy shall be set up separately for sampling for compliance check of labelling and for sampling for VOC content compliance check. It shall be reported, why the proposed amounts of samples are assumed to be representative and why the decision is expected to lead to a monitoring that ensures compliance with the requirements of the Directive 2004/42/EC.

The sampling strategy should include the decision, e.g.

- to take (during e.g. the site visit at of a company) one sample of each product category as definied in the Directive or
- to take one sample of each type of product manufactured in this product category (available at this company)
- to take samples once or during several site visits (each from the same product group or each from a different product group)
- to take a certain amount of samples in that company – based on a share of the overall production / of the stock of the company or based on the amount of different relevant types of products produced, etc</td></tr>
<tr><td>The sampling system depends on the structure of the national market and the structure of the individual units. In case that 60% of the manufacturers market is shared only by two major companies, it could be efficient to take one sample of each product type at each company.

In case that 60% of the market is covered by e.g. seven manufacturers, it could be more effective to take only one to three product types out of one product category at each company. Same is true for wholesaler, importers or DIY´s stores.</td><td colspan="2">The sampling system depends on the structure of the national market and the structure of the individual companies. In case that 80% of the market are shared by a few major companies only, it is recommended to take one sample of each product type at each company.

In case that 80% of the market are shared by e.g. seven or more companies, it could be more effective to take two to five product types out of one product category at each company. Same is true for wholesaler, importers or DIY´s.</td></tr>
</table>

<table>
<tr><th></th><th>Minimum Monitoring Programme</th><th>Good Practice Monitoring Programme</th><th>Best Practice Monitoring Programme</th></tr>
<tr><td rowspan="2">3.6 Sampling for monitoring of compliance with labelling requirements</td><td colspan="3">The samples shall be taken by an authority person or by a person/institution mandated by the authority. The labels should be monitored by visual check on the ready-to-sell product (not checked only by delivery of the label design to the authority).

The decision for the number of samples to be taken shall be linked to the proposal for “choice of samples”. The focus of label monitoring (for correct statement and for correct product category classification) shall be put on categories allowing a high VOC content of > 500 g/l.</td></tr>
<tr><td colspan="2">The amount of samples for compliance check of labelling is recommended to be at least triple of the amount of samples to be checked analytically for compliance of VOC content.</td><td>It is best practice to take one sample per product type in every company monitored.</td></tr>
<tr><td rowspan="2">3.7 Sampling for monitoring of the VOC content and amount</td><td colspan="3">The samples shall be taken by an authority person or by a person/institution mandated by the authority. The decision for the number of samples to be taken shall be linked to the proposal for “choice of samples”.</td></tr>
<tr><td>As minimum requirement, in total one samples of each product category shall be analytically checked (in case of water and solvent-based categories, samples of each category shall be analysed). The samples shall derive from different manufacturers.

In case of suspicion of non-compliance with the allowed VOC limit, samples of this product shall be taken and analytically checked.</td><td>As good standard requirement, in total two to three different samples of each product category shall be analytically checked (in case of water and solvent-based categories, samples of each category shall be analysed). The samples shall derive from different manufacturers.

In case of suspicion of non-compliance with the allowed VOC limit, samples of this product shall be taken and analytically checked.</td><td>As best standard requirement, in total one sample of every product type available per product category shall be analytically checked (in case of water and solvent-based categories, samples of each category shall be analysed). The samples shall derive from different manufacturers. At least one sample shall be taken out of each company monitored.

In case of suspicion of non-compliance with the allowed VOC limit, samples of this product shall be taken and analytically checked.</td></tr>
</table>

	Minimum Monitoring Programme	Good Practice Monitoring Programme	Best Practice Monitoring Programme
	Alternatively, the number of samples taken and analytically checked can e.g. be based on to the production / sales amounts per unit monitored. Any other alternative system can be chosen. The alternatively chosen system to calculate the amounts of samples to be checked shall not lead to fewer samples taken than recommended. The selected calculation system shall be documented explaining the reasons why it is expected to lead to representative results.		
3.8 Monitoring of the VOC content via analytical test methods *2004/42/EC (Annex III):* *ISO 11890-2 VOC content* *ASTMD 2369 VOC content where reactive diluents are present* *[ISO 11890-1 (not mentioned in Annex III]*	The VOC content has to be checked using the analytical test methods defined in Directive 2004/42/EC.		

Annex 24 Literature data

24. Product-specific VOC emission factors

Table 168: Overview of emission factors describing emission of VOC to air (in kg VOC emission * capita-1 * year-1) taken from literature

Product group/application	EF	Reference
Private household	2-3	Ponche et al. (2000)
Household cleaning and maintenance	1,15	BUWAL (2003)
Hairdressing salons	32	BUWAL (2003)
Cosmetic institutes	28	BUWAL (2003)
Strippers	0,03	BUWAL (2003)
Domestic aerosols	0,32	BUWAL (2003)
Industrial aerosols	0,18	BUWAL (2003)
Cosmetics	0,4542	Gent University (2002)
Car products	0,2076	Gent University (2002)
Leather and furniture maintenance	0,0324	Gent University (2002)
Household and stationary products	0,6293	Gent University (2002)
Domestic use of solvents	2	Klimont et al. (2000)
Insecticide spray	0,33	Gent University (2002)
Hair spray	0,26	Gent University (2002)
Deodorant spray	0,17	Gent University (2002)
Air freshener (aerosol)	0,14	Gent University (2002)
Car products (aerosol)	0,17	Gent University (2002)
Maintenance products (aerosols)	0,13	Gent University (2002)
Other aersols	0,10	Gent University (2002)
Total aerosols	1,30	Gent University (2002)
All purpose cleaners	0,23	Gent University (2002)
Glass cleaners	0,09	Gent University (2002)
Metal cleaner and polishes (non-aerosols)	0,02	Gent University (2002)
Carpet & upholstery (non-aerosols)	0,01	Gent University (2002)
Total cleaners	0,46	Gent University (2002)
Aerosol products	1,6	Gent University (2002)
Polishes	0,29	Gent University (2002)
Car window cleaners	0,29	Gent University (2002)
polishes and waxes	0,22	Gent University (2002)
Air fresheners	0,09	Gent University (2002)
Laundry products	0,02	Gent University (2002)
Cosmetics	0,64 – 1,0613	Gent University (2002)
Cosmetics non-aerosols	0,2366 – 0,4004	Gent University (2002)
Cosmetics aerosols	0,3848 - 0,5363	Gent University (2002)
Household products	0,2384 – 1,3377	Gent University (2002)
Household products non-aerosols	0,183 – 0,2307	Gent University (2002)
Household products aerosols	0,3469 - 0,0554	Gent University (2002)
Car products	0,3556 – 0,98	Gent University (2002)
Car products non-aerosols	0,3243 – 0,98	Gent University (2002)
Car products aerosols	0,1038	Gent University (2002)

* Some emission factors reported in the study of Gent University (2002) were collected from CARB and EPA

[IVAM, 2005, p. 78, Appendix V]

Annex 25 Literature data

25. VOC use and emissions from cosmetic products in 2004 in The Netherlands

Table 169: VOC use and emissions (kt/y from cosmetics in 2004, based on market survey data made available from NVC

Product category	Product use	Maximum VOC content (%)	VOC use*	Emission factor	VOC emission	VOC emission including professional 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

[IVAM, 2005, p. 18]