SURFACE CLEANING

SYNOPSIS SHEET

Prepared in the framework of EGTEI

1. Activity description and EGTEI contribution - summary

Surface cleaning is a process using organic solvents or water based products to remove impurities such as grease, fats, oils, waxes, carbon deposits, fluxes and tars from metal, plastic, fibre glass from printed circuit boards and other surfaces.
Several techniques for degreasing exist: use of solvents, of water based chemical detergents, ultra sound degreasing, supercritical CO_2 …
Solvents mainly used in surface cleaning are chlorinated solvents due to their efficiency and inin flammability.
Organic solvents are used in different types of equipments more or less efficient in terms of NMVOC emission management.

This activity emits NMVOC originating from the use of organic solvents (hydrocarbons and trichloroethylene). NMVOC emissions from this sector may vary significantly from country to country according to the rate of use of the different equipments and types of cleaning productc used. At a EU25 level for the year 2000 [6], NMVOC emissions were 268 kt representing 2.52% of total NMVOC emissions (according to the scenario CP_CLE_Aug04 (Nov04)). The average emission factor is about 0.394 g NMVOC/kg cleaning product, meaning that emissions from this sector are far to be treated in the EU25 (these data are provisional and could be modified in a near future after bilateral consultations scheduled in 2005).

Surface cleaning is addressed by the European Directive 1999/13/EC (SED) [1] related to the reduction of NMVOC emissions from solvent uses in some industrial activities. Moreover trichloroethylene is now classified R45. Emission limit values are very low. In order to be able to better represent the impact of this Directive in terms of emission reduction and costs, **surface cleaning has been considered as an individual activity by EGTEI [2]**. This sector was already considered separately in the previous version of RAINS [5] but **EGTEI provides updated data for cost estimation**.

The methodology for this sector was mainly developed from literature data and some industry expert data [3], [4] and [10] to [13]. RAINS module for surface cleaning has been modified and integrates EGTEI proposals.

Data provided by EGTEI (emission factors) are now implemented in the new RAINS version for the modelling work carried out in the scope of the CAFÉ programme and the revision of the Gothenburg Protocol and national emission ceiling Directive.

The representative unit used is the annual cleaning product consumption (t/year). Three reference installations (RIC) are defined to represent the typical installation sizes encountered in Europe. The small installation is just under the solvent consumption threshold above which SED directive applies.

Five primary measures are considered based on different machine types and solvents used: open top degreaser representing the no control equipment, semi-open top degreaser, cold cleaner, sealed chamber system with chlorinated solvent and A3 solvents (hydrocarbons with flash point higher than 55°C indicating low risk of flammability). The use of HFC and HFE in sealed chamber is not taken into account for simplification reasons and due to the low market share of these solvents but costs of these products are provided.
Activated carbon adsorption can be used to treat waste gases from open top and semi open top degreasers.

EGTEI provides default emission factors (EF) with abatement efficiencies, investments and variable and fixed operating costs (OC) as well as unit costs (€/t NMVOC abated and €/t textile) for eight combinations of primary and secondary measures for each installation size.
Solvent savings do not compensate investment costs in closed machines.

National experts have only to collect 4 country and sector specific parameters (costs of trichloroethylene, of A3 hydrocarbons, cleaning agents for water based cleaning systems and cold cleaning solvents. These parameters can be defined with the help of solvent producers and metal degreasing experts. EGTEI provides default costs for country and sector specific parameters which can be used if no better data exist. National experts have also to provide the trends in activity level from 2000 to 2020, the activity shares according to the different RI as well as the application and applicability rates of each abatement technique. **Costs range from 0.4 to 55.7 € / kg NMVOC abated in the smallest installation and from – 0.3 to 2.97 € / kg NMVOC in the largest one.** The impact of installation size is important. The highest costs are encountered on the smallest installation taken into account which is outside the scope of the Directive but can be considered in some Member state's regulation.

As the representation of this sector in RAINS is based on the EGTEI proposal, it is recommended to national experts to complete ECODAT with country specific parameters which are not known from CIAM.
In the future any new technology which could be developed, as cleaning with plasma process, biological process or supercritical $CO_{2,}$ should be considered by EGTEI in the background document to continuously improve the sector representation and the EGTEI capacity to describe new technologies.

2. European regulation

As mentioned above, the European Directive 99/13/EC [1] applies to this sector (annex IIA, n°4 and 5).
The SED applies to all installations above a certain solvent consumption. Emission limit values defined in the SED are presented in table 2.1. All obligations are not described in this chapter.

Table 2.1: Emission limit values for dry cleaning

	Solvent consumption threshold [t / y]	NMVOC emission limit values [mg NMVOC / Nm^3]	Fugitive emission limit values [% of solvent input*]
Solvents with risk phrase R40 or R45	From 1 to 5	20	15
	Above 5	20	10
Other solvents	From 2 to 10	75	20
	Above 10	75	15

The compliance date for existing installations is October 30th, 2007. Following the transcription of the Directive in Member States, this date can be different from country to country. For example, in France, the compliance date is October 30th, 2005.

3. Methodology developed within EGTEI to represent the sector

3.1 Definition of reference installations

Three reference installations (RI, but RIC for reference installation code in table 3.1.1) are defined. The representative unit used is annual solvent consumption per year.

Table 3.1.1: Reference installations

Reference Installation Code RIC	Description	Working time
01	Small installation bath surface 0.4 m^2	500
02	Medium installation bath surface 1.5 m^2	1500
03	Large installation bath surface 3.0 m^2	2000

3.2 Definition of emission abatement techniques

3.2.1 Primary measures

The main primary measure is the switch from open-top machines towards sealed chambers or water cleaning systems.

Single sealed chamber systems

This technique prevents direct exposure between the solvent and the atmosphere by a series of interlocks, and by the use of a vapour extraction and/or refrigeration system which recycles the vapour back into the solvent sump. These provide an extremely high degree of solvent containment and reduce fugitive emissions. These machines can work either with chlorinated solvents or with other solvents like hydrocarbons known as A3 class ((flash point larger than 55°C meaning these solvents are not flammable under current use but can become flammable during non controlled use (flammable solvents have a flash point < 55° C)), HFC or HFE.

Cold cleaners

Cold cleaners are mainly applied in maintenance and manufacturing. They are batch loaded, non-boiling solvent degreasers.

Cold cleaner operations include spraying, brushing, flushing, and immersion. In a typical maintenance cleaner, dirty parts are cleaned manually by spraying and then soaking in the tank. After cleaning, the parts are either suspended over the tank to drain or are placed on an external rack that routes the drained solvent back into the cleaner. The cover is intended to be closed whenever parts are not being handled in the cleaner. Typical manufacturing cold cleaners vary widely in design, but there are two basic tank designs: the simple spray sink and the dip tank. Of these, the dip tank provides more thorough cleaning through immersion, and often is made to improve cleaning efficiency by agitation.

Open-top vapour systems

Open-top vapour degreasers are batch loaded boiling degreasers that clean with condensation of hot solvent vapour on colder metal parts. Vapour degreasing uses halogenated solvents (usually perchloroethylene, trichloroethylene), because they are not flammable and their vapours are much heavier than air.

A typical vapour degreaser is a sump containing a heater that boils the solvent to generate vapours. Parts to be cleaned are immersed in the vapour zone, and condensation continues until they are heated to the vapour temperature. Residual liquid solvent on the parts rapidly evaporates as they are slowly removed from the vapour zone. Cleaning action is often increased by spraying the parts with solvent below the vapour level or by immersing them in the liquid solvent bath. Nearly all vapour degreasers are equipped with a water separator which allows the solvent to flow back into the degreaser.

Aqueous based cleaning systems

This technique consists of water, detergent and a small amount of solvents, and has been shown to provide a reasonable cleaning efficiency for certain applications. Besides acid cleaning baths, strong till weak alkaline and neutral products are used for industrial cleaning of hard surfaces. Neutral cleaners are predominantly applied for intermediate and final surface cleaning, whereas strong alkaline products aim at obtaining very clean surfaces before surface ennoblement, phosphatation or coating processes. Acid solvents are found in special applications. Water-based cleaning agents can be used for the cleaning of metals such as steel, aluminium, magnesium, copper, etc., but also for plastics, coated surfaces, glass and electronic parts. In large parts of industrial surface cleaning, water-based systems have been established; leading partly to even better cleaning results as former solvent-based systems. This effect is especially related to further processing of the substrate, such as coating. The two main techniques used in aqueous systems are immersion (small US tanks to multi-tanks system) and aspersion (small machines interoperations with complete tunnels).

Improvement of Equipment

For cold cleaners, bath evaporation can be controlled by using a cover regularly, by allowing an adequate freeboard height, and by avoiding excessive drafts in the workshop.

For open-top vapour systems, most emissions are due to diffusion and convection, which can be reduced by using an automated cover, by using a manual cover regularly, by spraying below the vapour level, by optimising work loads, or by using a refrigerated freeboard chiller (which may be replaced, on larger units, by a carbon adsorption device).

Table 3.2.1.1: Primary measures

Primary Measure Code PMC	Description
00	Open-top degreaser
01	Improvement of equipment : semi open-top degreaser
02	Sealed chamber system using chlorinated solvents
03	Cold cleaner
04	Sealed chamber system using A3 solvents
05	Aqueous cleaning process

3.2.2 Secondary measures

Emissions from open circuit machines can be reduced by the use of activated carbon adsorption.

Table 3.2.2.1: Secondary measures

Secondary Measure Code SMC	Description
00	No secondary measure
01	Activated carbon adsorber

Table 5.2 indicates what combination enables to be in compliance with the SED Directive.

4. Country specific data to be collected

Different types of country specific data have to be collected to give a clear picture of the situation in each Party. EGTEI proposes default values for the economical parameters which can be modified by the national expert if better data are available.
For this activity on contrary to other NMVOC sectors, country specific economical parameters are not used to calculate variable operating costs. However some country and sector specific parameters are necessary to calculate variable operating costs. They correspond to costs of different types of cleaning solvents. Default costs proposed by EGTEI are presented in table 4.1.

Table 4.1: Country and sector specific economic parameters

Parameters	Default costs provided by EGTEI [€ net of taxes/kg]	Country and sector specific costs [€ net of taxes/kg]
Trichloroethylene	1.25	To be provided by national experts
Cold cleaning agent	4.01	To be provided by national experts
A3 solvents	4.01	To be provided by national experts
Cleaning agent for aqueous cleaning process	1.67	To be provided by national experts

The best source of information for the determination of country and sector specific parameters is the national association of solvent producers and industry experts and it is recommended to national experts to contact them.
Default data have been used to calculate variable and annual unit costs presented in table 5.1.
Information concerning activity levels from 2000 to 2020 as well as the description of the control strategy is also required (these data can be directly entered in the database ECODAT). A full definition of the work to be done by national experts is provided in the general EGTEI methodology [8].
National experts can also modify the default unabated emission factor proposed by EGTEI to represent the reference situation for all Parties, in a range of ± 10% (with appropriate explanations).

Table 4.3: Unabated emission factor [g of NMVOC / kg cleaning product]

Default emission factor	Country specific emission factor
720	To be provided by national experts

5. Default emission factors and cost data defined with the EGTEI methodology

Table 5.1 presents an overview of all data provided by EGTEI for surface cleaning: default emission factors (EF) with abatement efficiencies, investments, and variable and fixed operating costs (OC) as well as unit costs per t NMVOC abated and per unit of activity.
Negative variable costs account for solvent savings. Fixed operating costs are only considered for secondary measures and correspond to 5% of the activated carbon adsorber investment (for maintenance and insurance). As insufficient data are available, fixed operating costs for the different machine types are assumed to be the same and zero consequently.
Technical characteristics of the reference installations are given in table 3.1.1.

Table 5.1: Default emission factors (EF), abatement efficiencies, investments, fixed and variable operating costs (OC) and unit costs for each combination

RIC PMC SMC	NMVOC EF [g NMVOC / kg cleaning product]	Abatement efficiency [%]	Investment [€]	Variable OC [k€ / year]	Fixed OC [k€/y]	Unit cost [€/kg NMVOC abated]	Unit cost [€/kg cleaning product]
01 00 00	710	0	0	0	-	0.00	
01 00 01	142	80	150 000	4 916	7 500	31.59	55.62
01 01 00	532,5	25	19 000	-183	-	1.86	10.49
01 01 01	106,5	85	169 000	4 879	7 500	33.63	55.73
01 02 00	35,5	95	85 000	-694	-	8.48	12.57
01 03 00	80	89	100	189	-	0.24	0.38
01 04 00	25	96	67 500	8	-	7.41	10.82
01 04 01	20	97	217 500	5 492	7 500	39.70	57.54
01 05 00	0	100	22 400	343	-	2.87	4.05
02 00 00	710	0	0	0	-	0.00	
02 00 01	142	80	170 000	2 776	8 500	2.66	4.68
02 01 00	532,5	25	39 500	-2 226	-	0.13	0.75
02 01 01	106,5	85	209 500	2 331	8 500	2.97	4.92
02 02 00	35,5	95	160 000	-8 459	-	0.59	0.88
02 03 00	80	89	2 400	2 308	-	0.25	0.40
02 04 00	25	96	155 000	100	-	1.40	2.05
02 04 01	20	97	325 000	9 800	8 500	4.75	6.89
02 05 00	0	100	42 000	4 181	-	0.80	1.12
03 00 00	710	0	0	0	-	0.00	
03 00 01	142	80	230 000	-4 933	11 500	0.78	1.37
03 01 00	532,5	25	65 000	-7 792	-	-0.06	-0.31
03 01 01	106,5	85	295 000	-6 491	11 500	0.90	1.49
03 02 00	35,5	95	250 000	-29 608	-	-0.20	-0.30
03 03 00	80	89	6 000	8 077	-	0.25	0.39
03 04 00	25	96	220 000	351	-	0.58	0.84
03 04 01	20	97	450 000	19 649	11 500	2.05	2.97
03 05 00	0	100	150 000	14 632	-	0.80	1.13

Investments correspond to the additional costs of semi top degreasers, sealed chambers and water based systems conventional compared to open top machines. Negative operating costs indicate that savings are obtained with the considered machines.
Unit costs [k€/t of NMVOC abated] are obtained by dividing the total annual additional cost of a measure by the amount of NMVOC abated (costs and emissions are compared to the uncontrolled measure PMC 00/SMC 00).
As presented in table 5.1, all unit costs are very high for small installations. Solvent savings do not counter balance investments and operating costs in this activity.
Unit costs are very different from the smallest reference installation to the largest one. Consequently, it is interesting to determine the structure of this activity in a given country.

Table 5.2 indicates combinations enabling compliance with the SED Directive.

Table 5.2: Combinations in compliance with the EC Directive 99/13

Combination code	Emissions kg NMVOC / year	Total consumption kg solvent or water based product / year	Emissions % of cleaning product consumption	flowrate kg NMVOC/hour	
01 00 00	582.2	820	71.0	1.164	Under the solvent consumption of 1 t per year
01 00 01	116.44	354.24	32.9	0.233	Under the solvent consumption of 1 t per year
01 01 00	436.65	674.45	64.7	0.873	Under the solvent consumption of 1 t per year
01 01 01	87.33	325.13	26.9	0.175	Under the solvent consumption of 1 t per year
01 02 00	29.11	267	10.9	0.058	Under the solvent consumption of 1 t per year
01 03 00	65.6	303	21.6	0.131	Under the solvent consumption of 5 t per year
01 04 00	20.5	258	7.9	0.041	Under the solvent consumption of 5 t per year
01 04 01	16.4	254	6.5	0.033	Under the solvent consumption of 5 t per year
01 05 00	0	820	0.0	0.000	In compliance in any case
02 00 00	7100	10000	71.0	4.733	Not in compliance (1)
02 00 01	1420	4320	32.9	0.947	Not in compliance (1)
02 01 00	5325	8225	64.7	3.550	Not in compliance (1)
02 01 01	1065	3965	26.9	0.710	Not in compliance (1)
02 02 00	355	3255	10.9	0.237	In compliance (2)
02 03 00	800	3700	21.6	0.533	In compliance (3)
02 04 00	250	3150	7.9	0.167	In compliance (4)
02 04 01	200	3100	6.5	0.133	In compliance (5)
02 05 00	0	10000	0.0	0.000	In compliance in any cases
03 00 00	24850	35000	71.0	12.425	Not in compliance (6)
03 00 01	4970	15120	32.9	2.485	Not in compliance (6)
03 01 00	18637.5	28787.5	64.7	9.319	Not in compliance (6)
03 01 01	3727.5	13877.5	26.9	1.864	Not in compliance (6)
03 02 00	1242.5	11392.5	10.9	0.621	Not compliance (7).
03 03 00	2800	12950	21.6	1.400	In compliance (8).
03 04 00	875	11025	7.9	0.438	In compliance (9).
03 04 01	700	10850	6.5	0.350	In compliance (10).
03 05 00	0	35000	0.0	0.000	In compliance in any cases

(1) Above the ELV for diffuse and stack emissions
(2) The quantity of solvent recycled is not exactly known. Taking into account total NMVOC emissions of 10.9% compared to consumption, it can be assumed that the machines comply with the EC ELV of 15% of solvent input + stack ELV (when solvent recycled is added to denominator the percentage decreases).
(3) The quantity of solvent recycled is not exactly known. Taking into account total NMVOC emissions of 21.9% compared to consumption, it can be assumed that the machines comply with the EC ELV of 20% of solvent input + stack ELV (when solvent recycled is added to denominator the percentage decreases).
(4) The quantity of solvent recycled is not exactly known. Taking into account total NMVOC emissions of 7.9% compared to consumption, it can be assumed that the machines comply with the EC ELV of 20% of solvent input + stack ELV (when solvent recycled is added to denominator the percentage decreases).
(5) The quantity of solvent recycled is not exactly known. Taking into account total NMVOC emissions of 6.5 % compared to consumption, it can be assumed that the machines comply with the EC ELV of 20% of solvent input + stack ELV (when solvent recycled is added to denominator the percentage decreases).
(6) Above the ELV for diffuse and stack emissions
(7) The quantity of solvent recycled is not exactly known. Taking into account total NMVOC emissions of 10.9 % compared to consumption, it can be assumed that, the machines comply with the EC ELV of 10% of solvent input + stack ELV (when solvent recycled is added to denominator the percentage decreases).
(8) Not in compliance. The quantity of solvent recycled is not exactly known. Taking into account total NMVOC emissions of 21.9 % compared to consumption, it can be hardly assumed that the machines can comply with the EC ELV of 15 % of solvent input + stack ELV (even if when solvent recovery is added to denominator the percentage decreases, the gap seems too large).
(9) The quantity of solvent recycled is not exactly known. Taking into account total NMVOC emissions of 7.9% compared to consumption, it can be assumed that the machines comply with the EC ELV of 15 % of solvent input + stack ELV (when solvent recycled is added to denominator the percentage decreases).

(10) The quantity of solvent recycled is not exactly known. Taking into account total NMVOC emissions of 7.9% compared to consumption, it can be assumed that the machines comply with the EC ELV of 15 % of solvent input + stack ELV (when solvent recycled is added to denominator the percentage decreases).

6. Relevance of EGTEI information for Integrated Assessment Modelling (IAM)

In the previous RAINS version [5], surface cleaning was already considered separately. EGTEI provides updated costs to consider in this sector. Data provided by EGTEI (emission factors and costs) have been implemented in the new RAINS version [6] for the modelling work carried out in the scope of the CAFÉ programme and the revision of the Gothenburg protocol.
The codification is as follows:

Name of measures in RAINS fro existing inst.	Name of measures in RAINS for new inst.
SLV-DEGR	
SLV-DEGR-ACA	
SLV-DEGR-BEMT	SLV-DEGR-NEW-BEMT
SLV-DEGR-BEMT-ACA	SLV-DEGR- NEW-BEMT-ACA
SLV-DEGR-CLSD-CL	SLV-DEGR- NEW-CLSD-CL
SLV-DEGR-CLSD-A3	SLV-DEGR- NEW-CLSD-A3
SLV-DEGR-CLSD-A3-ACA	SLV-DEGR- NEW-CLSD-A3-ACA
SLV-DEGR-CLSD-HF	SLV-DEGR- NEW-CLSD-HF
SLV-DEGR-CLSD-HF-ACA	SLV-DEGR- NEW-CLSD-HF-ACA
SLV-DEGR-WBD	SLV-DEGR- NEW-WBD

New installations are considered in RAINS. For these installations the reference for cost calculation corresponds to SLV-DEGR-NEW-BEMT.

For this activity, data provided by national experts through ECODAT can then be directly used by IIASA for introduction in the RAINS model.

7. Perspective for the future

In the future, any new technology which could be developed or become wide spread as supercritical machines should be considered by EGTEI in the background document to continuously improve the sector representation and the EGTEI capacity to consider new techniques.

8. Bibliography

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ANNEXE: Example of data collection and use of EGTEI data – Case of France

A. Country specific data collection and scenario CLE developed

The French national expert has been able to complete ECODAT for the surface cleaning sector with the help of CITEPA [9].
All data have been provided to CIAM for the bilateral consultation France – CIAM in March 2004.
Country and sector specific parameter costs have been defined from information provided by industry experts.

Country and sector specific economic parameters

Table A.1: French and sector specific costs

Parameters	French and sector specific costs
Trichloroethylene [€ net of taxes/kg]	1.25
Cleaning solvent for cold cleaners [€ net of taxes/kg]	4.01
A3 Hydrocarbon solvents [€ net of taxes/kg]	4.01
Water based cleaning agents [€ net of taxes/kg]	1.67

The default values have been used for France.

Activity level

The use of cleaning agent in 2000 has been estimated from data collected for the French emission inventory [7] and expert estimate on the use of water based cleaning product.
The trend of surface cleaning activity from 2000 to 2020 has been defined by the French national expert.
Respective shares (kt cleaning products/year) of total activity carried out on each reference installation in 2000, 2005, 2010, 2015, 2020 is provided in table A.2.

Table A.2: Activity levels on Reference Installations (kt cleaning solvent / year)

RIC	2000	2005	2010	2015	2020
01	24481	25718	26954	28190	29613
02	33383	35069	36755	38441	40382
03	53413	56111	58809	61505	64611
Total	111278	116898	122518	128135	134606

Unabated emission factor

Default emission factors are adapted to the French situation.

Current legislation control scenario (CLE)

In the current legislation control scenario (CLE), the application rates of the different abatement techniques depend on the regulation implemented and on the compliance dates.

For 2000, the rates of use of the different reduction techniques are determined to be in compliance with emission estimate from emission inventories [4].

The application rates and applicability factors for the CLE scenario are presented in table A.3.

Table A.3: Definition of the CLE scenario

RIC PMC SMC	Application rate in 2000 [%]	Application rate in 2005 [%]	Appl. [%]	Application rate in 2010 [%]	Appl. [%]	Application rate in 2015 [%]	Appl. [%]	Application rate in 2020 [%]	Appl. [%]
01 00 00	0	0	100	0	100	0	100	0	100
01 00 01	0	0	100	0	100	0	100	0	100
01 01 00	50	50	100	50	100	50	100	50	100
01 01 01	0	0	100	0	100	0	100	0	100
01 02 00	0	0	100	0	100	0	100	0	100
01 03 00	2	2	20	2	30	2	30	2	30
01 04 00	3	3	60	3	80	3	80	3	80
01 04 01	0	0	60	0	80	0	80	0	80
01 05 00	45	45	50	45	60	45	70	45	80
Total RIC 01	**100**	**100**	**-**	**100**	**-**	**100**	**-**	**100**	**-**
02 00 00	0	0	0	0	0	0	0	0	0
02 00 01	0	0	0	0	0	0	0	0	0
02 01 00	50	0	0	0	0	0	0	0	0
02 01 01	0	0	0	0	0	0	0	0	0
02 02 00	2	47	80	40	100	20	100	15	100
02 03 00	0	2	5	2	5	3	10	3	5
02 04 00	0	4	60	8	60	10	70	10	70
02 04 01	0	0	60	0	60	2	70	4	70
02 05 00	46	47	50	55	55	65	65	68	70
Total RIC 02	**100**	**100**	**-**	**100**	**-**	**100**	**-**	**100**	**-**
03 00 00	0	0	0	0	0	0	0	0	0
03 00 01	0	0	0	0	0	0	0	0	0
03 01 00	55	0	0	0	0	0	0	0	0
03 01 01	0	0	0	0	0	0	0	0	0
03 02 00	3	52	80	44	100	33	100	30	100
03 03 00	0	0	5	0	5	0	0	0	0
03 04 00	2	3	60	6	60	10	80	12	80
03 04 01	0	0	60	0	60	2	80	3	80
03 05 00	40	45	45	50	50	55	55	55	70
Total RIC 01	**100**	**100**	**-**	**100**	**-**	**100**	**-**	**100**	**-**

Appl.: applicability factor

B. Trends in emissions and total costs of the CLE scenario

Data presented in the table below are directly provided by ECODAT and based on input parameters defined in chapter A.

Table B.1 presents NMVOC emissions from 2000 to 2020 and total annual costs of emissions reduction for the CLE scenario.

Table B.1: Trends in emissions and total annual costs of emission reductions in the CLE scenario

	2000	**2005**	**2010**	**2015**	**2020**
NMVOC emissions	**t NMVOC**	**t NMVOC**	**t NMVOC**	**t NMVOC**	**t NMVOC**
CLE scenario	31231	8662	8901	8947	9320
Annual total costs	**k€/year**	**k€/year**	**k€/year**	**k€/year**	**k€/year**
CLE scenario	91612	103411	115596	132006	144738

EGTEI approach allows representing NMVOC emissions from surface cleaning very well. With EGTEI methodology, emissions estimated in 2000 in scenario CLE are totally consistent with what the French emission inventory [7].

With the CLE scenario emissions are reduced compared to the NOC scenario. The MFR scenario enables additional reductions with higher costs.