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Product Policy in the Context of the Indoor Environment Quality

Final Report

M. Spruyt[1], M. Kuske[2], E. Goelen[1] and J. Nicolas[2]

[1]: VITO, Environmental Measurements
[2]: ULg, Dept des Sciences et Gestion de l'Environnement

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0 Management Summary

In the past, materials containing unhealthy substances were used uncritically, creating sources of long term emission and, as a consequence, a clean up requirement in many buildings. Well known examples are formaldehyde (emissions from wood based materials), pentachlorophenol and its water soluble sodium salt (wood preservatives) and polychlorinated biphenyls (insulating materials). Today, many people living in modern industrial regions, particularly during the colder months, spent up to 90 % of their time in closed rooms with only short airing periods. Combined with increased heat insulating measures, again it may result in increased indoor concentration levels for certain contaminants that potentially have adverse effects on human health.

In this context, countries worldwide deployed a product policy in general and intentions rise to more and more orientate this policy towards the protection of the indoor environments. In this project, for 14 priority contaminants and five countries, an inventarisation has been made to verify the specific product policy measures undertaken (in the context of protecting the indoor environments) as well as the overall indoor environment policy.

Regulations aiming to limit usage of certain toxic substances, and concerning products used indoors are rather scarce. European countries apply European directives and recommendations, and make very rarely their own initiatives. For this reason, the substances regulated already in the Directive of dangerous substances are also regulated on the national levels. Up to date, the usage of only few substances is regulated. These are most often: formaldehyde, benzene, some glycol ethers, brominated flame retardants, chlorinated solvents, vinyl chloride.
Regulations aiming to limit the indoor concentrations of contaminants are a tool applied by various countries. Unlike expected, only very few substances are regulated in this way and the policy is applied in order to enhance and evaluate source control measures. Substances quite often regulated are: carbon dioxide, ammonia, asbestos, formaldehyde, carbon monoxide, PM10, radon and a set of VOCs, both at the individual and total VOC level. Some countries include also physical characteristics and biological particles.

Voluntary agreements play an important role, especially if they can contribute to reducing exposure more rapidly or effectively than legally enforceable national or international regulations. Labelling system is an example of a voluntary action that does not limit the market. Very often, labelling systems incite producers to improve their products, and to develop better technologies. They are easier to modify, which ensures rapid application of the latest knowledge.

Different kinds of publications on indoor air quality appeared in some countries: guides, reports, articles and books at the popular science level. This action meets the need to better inform consumers on the environmental characteristics of products and to encourage producers to systematically develop better products.

All product and indoor environment policy measures detected during this (small scale) project are summarized in this report, while the original back up documents are saved into a new (access based) database, which is developed to be further extended in the future.

1 Introduction

The Belgian Federal Government, in cooperation with the Regions and Communities, has launched mid February 2005 a three manmonths study entitled: "Product Policy in the context of the Indoor Environment". The study was executed by VITO (Flemish Institute for Technological Research) and ULg (Université de Liége – Département des Sciences et Gestion de l'Environnement).
The aim of the project was to collect and summarize information on the indoor product policy currently applied in a selection of countries. The objectives are to obtain information on the:

- product policy measures in 5 countries for 14 indoor contaminants;
- product policy measures in these countries for other chemical indoor contaminants;
- overall indoor environment policy.

This includes existing and planned measures, results of these measures, how to prioritize, workers protection, possibilities to replace certain substances, …

The fourteen priority indoor contaminants considered are those selected by the participants of the Eupen workshop (4 June 2004); the five selected countries, where most efforts were put in, were: Finland, Sweden, France, Germany, California (USA). In addition, an overview for three other countries is included: Denmark, Canada, and Poland.

Mainly summarizing documents and conclusions are put together in this final report. More detailed information (references, back-up documents, reports, websites, international symposia, other databases…) is saved into a new database, which is enclosed on CD-ROM.
The final report presents the collected information in a summary way. Chapter 2 describes the main phases of the project. The following chapter contains the information on product policies in selected countries, the most pertinent information on selected 14 substances, including their regulations, as well as national measures applied to improve the indoor air quality. The last part of the chapter 2 presents different voluntary actions, and other measures useful in establishing of products policy.

The process of collecting information has lead stepwise to a good insight in the product and indoor environment policy in the various countries. Efforts done existed for instance in sending out questionnaires and e-mails to contact persons, where required in combination with personal interviews and phone calls. A one day workshop was organized (Brussels, 7 October 2005) where speakers from 5 countries:

- presented an overview of the topic;
- took part in a round table discussion and were interviewed.

All the information obtained as such, was then further completed with reports, policy documents and websites found by literature and internet searches. As a result, over 100 documents are saved into the new database, which may be considered already in this stage, as an indispensable tool for further developing a product and indoor policy in Belgium and its Regions.

The database, workshop, listed references and summarizing documents are to be considered as the most important output of this project. Key findings are summarized into a horizontal analysis (Chpt 3) across all countries, taking into account the different questions raised by

the steering committee during the course of the project. It is required to consult, for underlying details, appendix 3, the references and documents in the database

2 Collection of Information: Process and Results

2.1 Contact List and Questionnaire

Contact persons were identified in 8 countries being Denmark, Sweden, Finland, France, Canada, Germany, UK and California (USA). Full affiliation for each one and a short description of the employer are incorporated into the database (Appendix 4). A total number of 67 contact persons have been identified for these 8 countries. The selected key contact persons are summarized below. They provided a majority of the policy documents (or tips to find the information) and/or reviewed the summaries per country (Appendix 3).

Table 1: Key Contact Persons (up to two) per Country

Country	Name	Institute
Denmark	T Witterseh F Gamél Christensen	Danish Technological Institute Danish Working Environment Authority
Sweden	M Becker A Thors	National Board of Health and Welfare Swedish Chemicals Inspectorate
Finland	J Sateri	Finish Society of IAQ
France	N Tchilian C Mandin	French Ministry of Health INERIS
Canada	N Gilbert L Wardell	Health Canada (Ministry of Health) Consumer Product Safety Bureau
Germany	G Lucke-Brunck W Misch	Federal Ministry of Environment Deutschen Instituts für Bautechnik (DIBt)
UK	R Maynard Les Fothergill	Dept (Ministry) of Health Office Deputy Prime Minister
California(USA) USA	H Levin S Womble	Building Ecological Research Group EPA

A representative selection of the contact persons in these eight countries received a questionnaire. The questionnaire part 1 was set up to detect the contact persons able to provide detailed information on the required topics. Part 2 of the questionnaire was afterwards sent to the identified key contact persons, able to actually provide the required information. The main idea was to receive either completed questionnaires or a list of documents (websites, reports, publications, databases, legislation sites,..) where further detailed information could be found.
The following topics were enclosed in the questionnaire and summarizes well the information looked for in this project.

Product Policy
Which product policy measures* are implemented in your country in order to reduce/prevent indoor pollution due to the 14 pollutants (formaldehyde, 1,2,4 trimethylbenzene, α–pinene, toluene, triclosan, methylene-di-isocyante, glycol ethers, permethrin, D-limonene, benzene, acetaldehyde, vinyl chloride, trichloroethylene, brominated flame retardants) listed in the table below?
* meant are measures to reduce direct indoor sources; measures for indirect sources (infiltration, outdoor environment, personal behaviour) are excluded

Product policy measures envisaged for each pollutant are:

- list of measures taken;
- list of measures in preparation;
- list of results obtained (e.g. observed decreased concentration levels, evaluation reports on results of policy measures, observed effects of substitution products, evaluation reports on the implementation and/or enforcement).

Indoor Environment Policy

- Which policy instruments are used and which authority is (authorities are) responsible for implementation/enforcement?
- What is in your country the importance of product policy measures as compared to other indoor policy instruments (e.g. in terms of man power, financial means, realizations)?
- Which contaminants have priority for the indoor environment policy. Please mention the contaminants tackled by source approach (e.g. product policy) and those subject to exposure reduction measures (e.g. measures in the context of personal behaviour, ventilation, building characteristics/design,…). Is there a (public available) scientific back up document to support this priority list of contaminants?
- Which are the guideline or limit values for indoor contaminants in your country?
- Which are the indoor policy measures focused on specific target groups (e.g. young children, elderly, disabled,...)?
- Where can we find the (public available) results of indoor research programmes/projects (e.g. database, websites,..) executed in your country?
- What budget is spent to the indoor environment policy (e.g. estimation in terms of man power, estimated annual budget for research, estimated annual budget for the indoor policy) in your country?
- Which are the evaluation criteria to verify the effectiveness of the indoor policy?

The information received and collected by means of the questionnaire is either available in the database, Appendix 4 (database path: query database/select a country/display contacts/quest. part 1 and 2) or as a summary per country in Appendix 1 together with a blanc questionnaire. The questionnaire output is to be considered as the starting point for further contacts, literature and website searches.
Some of the completed questionnaires contained answers on the questions, but in most cases, they gave only a hint of where to find the information. For some questions, there was simply a mention that no information is available. If there were no answers or the replies were insufficient, further verification of printed documents and documents available in Internet was carried out. The information obtained was verified with the experts from the selected countries.
The conclusion from the questionnaire survey is that the received questionnaires contain mainly (only) blanc fields.

2.2 Workshop

An important event of the project was the workshop, organised in the Eurostation building, in Brussels, on October 7th (2005) in order to obtain relevant information by direct contact with the appropriate persons.

Before the workshop, the key reference delegates from the five countries were chosen according to their representativeness, their expertise in the area and their availability.

The workshop itself was split up into two parts. The morning session was dedicated to the oral presentations of the five delegates coming from USA (California), Sweden, Finland, France and Germany. The second part of the workshop, during the afternoon, was a round table session. It consisted in an open discussion, based on pro's and contra's of currently implemented product policies. It allowed to acquire additional pieces of information with the aim of answering the question "What product policy for Belgium?".

Only the morning session was open to a selected public. A total number of 44 participants were present in the audience (in spite of the troubles generated by a national strike). They came from different circles: research institutes, laboratories, government, NGO's, consumer protection agencies, …

During the morning session, chaired by Jacques Nicolas (ULg), the five following speakers introduced the specific national product and indoor policies of their countries:

- Hal Levin, from the Building Ecology Research Group, in California, USA,
- Marie Becker, from the National Board of Health and Welfare, in Sweden,
- Jorma Sateri, from the Finnish Society of Indoor air Quality and Climate,
- Nathalie Tchilian, from the French Ministry of Health,
- Reinhard Oppl, from Eurofins, in Germany.

The presentations of each speaker are included in the proceedings of the workshop. (Appendix 2)

The afternoon round table, chaired by Eddy Goelen (VITO) and Catherine Bouland (Institut Bruxellois pour la Gestion de l'Environnement, IBGE/BIM), was a discussion about the following topics:

- Should product policy be product orientated or contaminant orientated?
- Is there an independent framework to guarantee quality of the voluntary labels?
- Is a global approach for product policy possible in Europe? What legislation/regulation? Who is responsible?
- What about the quantities of toxic substances mentioned on the labels?
- What is the effect of introducing a label?
- How can one initiate a labelling system?
- How about legislation/guidelines? Can one import outdoor limits to indoor environment and transfer ambient source tackling strategies to the indoor environment?

Finally, the workshop ended with a personal interview of the delegates from Sweden, Finland and USA.
They permitted to more clarify some concepts, ideas or practical policy set-ups. Even than not all the questions could be answered on. Those private conversations, outside the atmosphere of the official workshop were particularly useful to get information about problems and limitations of the different policies.

The minutes of the round table discussion, the preparatory document and the summary of the interviews are presented in Appendix 2.

2.3 Database

The contact persons, the questionnaire with the documents from the follow-up phones and e-mails, the workshop slides and documents from internet and literature searches (websites, reports, publications, databases, legislation sites) as well as key references are grouped together into one Access based database. The database includes in addition information for the fourteen priority substances more or less in the Eupen format. The main reason however to set up the database was to find a means for fluent consultation of documents and references obtained through internet and literature searches.

For the final five countries selected (Sweden, Finland, France, Germany and California), the database incorporates the essential back up policy documents with full details about the product and indoor environment policy; database path: query database/select a country/display documents (e.g. 19 for Germany) or display website (e.g. 8 for Germany). The most important documents were read and summarizing conclusions are grouped per country in Appendix 3 (8 countries). The resulting overall analysis across countries is presented in Chpt 3.

The structure of the database is designed for further use in the future and not only to incorporate the underlying policy documents. The current structure features a complete distinction between the pollutants of interest, the related policy, corresponding guidelines, countries, documents and websites. Connecting these tables with relationships, allows searching and grouping the information in the database any way desired.
The main tables are those containing:

- information on 14 priority pollutants;
- product policy for these compounds;
- contact persons in several countries that might be contacted for questions;
- backup documents and references that were consulted for the project;
- websites where additional information can be found.

These tables can be consulted directly (e.g. >Query Database>Select a Contact) or they can be accessed through one of the built-in pathways. Queries have been constructed to group by country (> Query Database>Select Country), pollutant (> Query Database> Query Pollutant) or by product (>Query Database> Select Product).

To guarantee an easy consultation of the referenced documents and websites, search fields have been constructed. The websites' descriptions can be searched for key words. For the documents, the titles, authors and descriptions have been made searchable. Fields with important policy documents contain in addition a short (few lines) introduction to the document.
For example, to search the reference: "AgBB 2004. Health-related Evaluation Procedure for Volatile Organic Compounds Emissions (VOC and SVOC) from Building Products" you have to open the database, go to "Query database", open the item "search documents by keywords". Press the search button after filling in either a part of the title in the "search text in title" field (e.g. evaluation), the author in the "search text in author " field (e.g. AgBB) or a keyword in the "search text in description" field (e.g. LCI). Click on the document found (becomes blue) and follow then the buttons to open the full document. In this way, all mentioned references can be easily traced back in the database.
The CD-ROM with the database is enclosed as Appendix 4.

3 Product and Indoor Environment Policy for 5 Countries: Summarizing Analysis

3.1 Product Policy on 14 Selected Pollutants

3.1.1 Regulations Based on European Legislation

The legislation concerning products used indoors is rather scarce.
European countries apply European directives and recommendations, and make very rarely their own initiatives. For this reason, the substances regulated already in the Directive of dangerous substances are also regulated on national level. Up to date, the usage of only few substances is regulated: formaldehyde, benzene, some glycol ethers, brominated flame retardants, chlorinated solvents, vinyl chloride.

Benzene
Benzene may not be used in concentrations equal to or greater than 0.1 % by mass in substances or preparations placed on the market.
Remark: benzene is not permitted in toys or parts of toys where the concentration of benzene in the free state exceeds 5 mg/kg of the weight of the toy or part of toy (Directive 76/769/EEC).

Brominated flame retardants
Use of polybrominated biphenyls (PBBs) and tris(2,3-dibromopropyl)phosphate (TRIS) is forbidden in textiles intended to come in contact with the skin. This prohibition is in accordance with EC Directive 83/264 which is implemented in EC Directive 76/769.
The Directive 2003/11/EC prohibits the placing on the market and the use of pentaBDE and octaBDE. As the presence of pentaBDE or octaBDE in concentrations higher than 0.1 % can be identified using standard analytical techniques such as GC-MS (gas chromatography-mass spectrometry), this is the limit value of these substances in products. According to the same directive, the use of decaBDE shall be banned by January 2006.
Tetrabromobisphenol A (TBBP A) and hexabromocyclododecane (HBCDD) are currently the subject of risk assessment under the EU's Existing Substances programme.
In Germany, some flame retardants are regulated, eg. the maximum mass content of PentaBDE and OctaBDE in products is 0.1% as specified by Directive 2003/11/EC.

Glycol ethers
Four glycol ethers are restricted for only professional usage: ethylene glycol ethyl ether, ethylene glycol methyl ether, and their acetates (Directive 76/769/EEC).

Vinyl chloride
Chloro-1-ethylene (vinyl chloride monomer) may not be used as aerosol propellant for any use whatsoever (Directive 76/769/EEC).
Remark: the Directive 78/142/EEC specifies that materials and articles which are intended to come into contact with foodstuffs must not contain vinyl chloride monomer in a quantity exceeding 1 mg/kg of finished product and must not pass on to foodstuffs more than 0.01 mg/kg of vinyl chloride monomer.

3.1.2 National Regulations

In most countries, there is no direct product policy in function of the indoor air quality. Limits on composition do however influence the indoor air quality, since pollutants that are banned, can not be emitted by products.

Benzene
The U.S. Consumer Safety Protection Commission considers products containing more then 5 % benzene hazardous and requires that they are marked with labels.

Brominated flame retardants
Despite the lack of national activities, there is a tendency in many countries to limit or forbid usage of brominated flame retardants Finland has urged the restriction of their use in the OSPAR (The Convention for the Protection of the Marine Environment of the North-East Atlantic) framework. Sweden and Denmark have put them on lists of undesirable substances.
Sweden was planning to impose a ban on all brominated flame retardants. However, the Swedish government decided that this measure would be ineffective. In fact, it is improbable that major manufacturers modify their products for such a relatively small market like in Sweden. In November 2004, the Swedish Chemicals Inspectorate (KEMI) issued a report in support of a national ban on decaBDE. The report states that the use of decaBDE is not required by fire protection standards and that alternative substances or methods are available to ensure fire safety. Finally, the report concludes that a national ban on decaBDE is appropriate based on the precautionary principle (KEMI, 2004).
The ecolabel systems, the TCO'95, the Blue Angel, and the Nordic Swan, restrict the use of BFRs. Polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs) may not be used in housing of electronic products, and may not exceed 50 g in plastic parts of copying machines. Coffee machines should be fabricated without any brominated flame retardants.
In the United States, State of California, a regulation has been made that no product shall contain more then 0.1 % of penta- or octaBDE. The regulation will be effective on 1 January 2006.

Formaldehyde
Formaldehyde is regulated in most countries. In Denmark, the Building Act regulates formaldehyde usage in particleboards, other wood based products and insulation foam. The regulation fixes the maximum emitted formaldehyde to 0.15 mg/m3 measured in a test room of 225 litres under standard conditions. Sometimes it is impossible to document that the conditions have been met. In this case it is only permitted to use boards with a maximum free formaldehyde content of 25 milligrams per 100 grams dry substance in the board (The Statutory Order from the Ministry of Environment and Energy No. 289 of 22 June 1983 on restricting formaldehyde in chipboard, plywood and similar board materials used in the manufacture of furniture, fixtures and fittings, and similar).
Emissions from chipboard, plywood, fibreboard, blackboard and similar wood based panels containing formaldehyde based resins should not lead to concentrations exceeding 0.13 mg/m³, based on testing in a 1 m³ chamber according to Swedish Standard 27 02 36. Sweden has also banned use of formaldehyde in cosmetics.
In Finland, the regulation concerns particleboards, other wood-based products, furniture, and insulation foam emitting formaldehyde. The formaldehyde content of room air is not

allowed to be higher than 0.15 mg/m³ in air measured according to the Finnish standard SFS 3862.
The legislation of formaldehyde in France is limited to the use of urea-formaldehyde foams in buildings intended for permanent or semi-permanent human occupation. The content of formaldehyde coming from wall insulated with urea-formaldehyde foams should not exceed 0.2 ppm per volume, in every room (French Décret n° 88/683).
In Germany, emissions from all building products are limited to a maximum of 0.1 ppm. The U.S. Department of Housing and Urban Development (HUD) has set limits for formaldehyde emissions from plywood and particleboard used in mobile homes. Test chamber concentrations are not to exceed 0.2 ppm and 0.3 ppm, respectively, to maintain indoor air concentrations of formaldehyde in mobile homes below 0.4 ppm
Formaldehyde and products containing 1% or more of formaldehyde are considered "strong sensitizers" by the US CPSC and must contain a warning label.

Glycol ethers
In France, four glycol ethers are totally forbidden in cosmetics, hygiene products and drugs: methyl glycol (EGME), ethyl glycol (EGEE) and their acetates (EGMEA et EGEEA) (Arrêté du 7 août 1997 modifié par arrêté du 13 octobre 1998).

Permethrin
Currently, US EPA is intending to develop a Reregistration Eligibility Decision (RED) for permethrin through a modified 4-phase public participation process that the Agency uses to involve the public in developing pesticide reregistration and tolerance assessment decisions.

Trichloroethylene
Four countries have established legislation on trichloroethylene: Sweden, Germany, Denmark and Norway. In Sweden, the use of chlorinated solvents (dichloromethane, tetrachloroethene, tetrachloromethane, trichloroethane and trichloroethylene) in consumer products is banned. Prohibition of professional use of trichloroethylene is effective since 1st January 1996.
Norway implemented a tax per kilo on both trichloroethylene and tetrachloroethene. Germany has employed very tough technical requirements concerning emissions that apply to both trichloroethylene and tetrachloroethene.
A complete prohibition on all use of trichloroethylene in Sweden has not been however wholly effective. The ban created strong opposition among some users, who either found it particularly difficult to replace trichloroethylene or simply disapprove of the timing or policy method. Some firms spent a great deal of effort and resources in appealing and lobbying against the ban, and gather support from industry associations. The evidence shows that in most cases, substitution of other chemicals for trichloroethene is relatively cheap. Sterner and Slunge compared the ban in Sweden with policies applied in Norway and Germany. The use of both substances has been drastically reduced in Germany and in Norway, whereas in Sweden, the objective to eliminate trichloroethylene was not achieved, and the same or even better result could be obtained at lower cost when employing another kind of policy (Sterner and Slunge, 2001; Slunge, 2003).
In 1995 the Danish Parliament adopted a tax on the use of the most common chlorinated solvents (tetrachloroethylene, trichloroethylene and dichloromethane) to provide an incentive for reduced consumption, for instance by switching to less hazardous substances. The tax resulted in an approximate 25% increase in the price of chlorinated solvents in Denmark when it was introduced. The tax is also levied on products that contain the

specified chlorinated solvents. After introducing the tax, the consumption of chlorinated solvents has fallen by approx. 60% from 1995 to 1999.
To prevent increased use of Toxic Air Contaminants, the Californian Air Resources Board has prohibited the use of three chlorinated solvents: tetrachloroethylene, methylene chloride, and trichloroethylene in 13 categories of products including general purpose degreasers, brake cleaners, all spray paints, all aerosol adhesives and adhesive removers.

Vinylchloride
In the United States, the U.S. Consumer Safety Protection Commission has banned the use of vinylchloride monomer in household products.

3.1.3 Information on the substances of interest

Fourteen chemical substances were selected to be evaluated during the project. Information on physical and chemical proprieties of the substances, their influences on human health and the environment, as well as actions undertaken in view to limit usage of the substances was researched and analysed. Following findings have been noted:

Acetaldehyde is a metabolic intermediate in humans and higher plants, and a product of alcohol fermentation. The main source of human exposure to acetaldehyde is through the metabolism of alcohol. Indoor high concentrations can be due to combustion sources such as cigarettes and fireplaces. It is used also in production of perfumes, varnishes, disinfectants, room air deodorants, and as a food flavouring agent. Moderate concentrations of acetaldehyde can provoke eye and respiratory tract irritation. However, the concentrations measured indoors are generally lower than those causing health effects (WHO 1995). Canada established limit value of exposure at 9 mg/m^3 (5 ppm). The substance is not regulated in other countries. There is not enough information available to decide with certitude if acetaldehyde should be regulated, and to which extend. The IARC placed it in group 2B (very limited prove of its carcinogenicity to humans and animals).

Benzene is a recognized carcinogen classified in group 1 (IARC). Chronic expositions may result in bone marrow damage, development of various types of leukaemia, irritations and neurotoxic troubles (Health Canada, 1993; BA et al., 2002; INRS, 2004; INERIS, 2005). It is present in many products such as paints, glues, detergents, furniture wax. Benzene is regulated by European legislation that limits its content in chemical products up to 0.1 % of total weight. In the United States, benzene was voluntarily withdrawn from consumer products.

Brominated flame retardants (BFR) are substances used in different products to reduce fire-related injury and property damage. They are added to polymers used in electronic and electrical equipment, textiles, foam furniture, insulating foams, and other building materials. As the number of these substances is very large, their evaluation in this project was limited to the most often used, and mostly mentioned in the literature: tetrabromobisphenol A (TBBPA), hexabromocyclododecane (HBCD), pentabromodiphenyl ether (pentaBDE), octabromodiphenyl ether (octaBDE) and decabromodiphenyl ether (decaBDE). The toxicology database for these substances is very limited; the current literature is incomplete and often conflicting. They are supposed to provoke endocrine disruption, particularly perturbation of thyroid homeostasis, developmental neurotoxicity, and immunotoxicity. They are persistent and bioaccumulative (WHO, 1997; Danish EPA, 2000; de Wit, 2000; Jacobsson et al., 2002; Masten, 2000; Madsen, 2003; Vos et al., 2003; Birnbaum, 2004).

Some BFR are regulated by European legislation. Labelling systems restrict the use of all BFR in electronics and electrical devices. Several countries put them on priority lists, and prepare to establish restrictions.

Formaldehyde is used in many materials and products for indoor use. Wood-based panels and insulation foams are its major sources, but it can be found also in paints, glues, textiles and cosmetics. Formaldehyde causes irritation of respiratory tract and eyes; it can amplify respiratory allergy and asthma. Nasopharyngeal or sinus cancer induced by formaldehyde can appear after long exposure to high concentrations. (WHO 1991) Formaldehyde is the only substance for which there are guidelines for indoor air, and regulations for building materials in almost every country. It is the N°1 priority substance in France. The guidelines for indoor air are generally about 0.1 mg/m^3 (80 ppb). World Health Organization advises not to exceed 0.01 mg/m^3 (8 ppb) in presence of persons sensible on this substance. Recently, it is a recognized carcinogen classified in group 1 (IARC 2004). The emission of formaldehyde from materials is usually limited between 0.13 mg/m^3 (104 ppb) and 0.15 mg/m^3 (12 ppb). Its content may not exceed 25 mg per kg of material.

Glycol ethers appear in indoor environments since they are present in water based paints and lacquers as cosolvents. They are mainly applied next to hydrocarbons and alcohols. Glycol ethers have special importance as ingredients of paints, lacquers, glues and paint removers. They are in addition used as solvents for e.g. cosmetic additives, inks, textile and leather dyes. Glycol derivatives are colorless and of different volatility. Human exposure to these contaminants may occur through inhalation, ingestion and skin contact. Indoors, inhalation is the main path for intake. Not all glycol derivatives (42 compounds) are considered as harmful. Some may irritate the mucous membrane of eyes and respiratory tract, can cause headache and in high concentrations (not measured in dwellings) show narcotic effects. Overall, little information from animal testing and occupational medicine is available. It is therefore not possible to describe the risk assessment of glycols in indoor air on a toxicological basis. There are e.g. in Germany some proposed indoor guideline values for seven glycol derivatives ranging from 30 to 170 $\mu g/m^3$. Overall, to present knowledge, exposure indoors to values at or below these levels will not impair the health.

Limonene is both a naturally occurring and a synthetic liquid. It is used as solvent, in household cleaning products, cosmetics, furniture polishes and room fresheners. Reaction of mixture of terpenes and ozone may result in formation of unidentified strong upper airway irritants. Limonene has irritant (skin, eyes) and sensitizing properties (WHO, 1998; NICNAS, 2002). The information on its effects on the health is still incomplete, so it is difficult to form an opinion about the necessity to regulate it. Limonene and other terpenes were on the Finnish list of proposed national priority substances, but it was removed from the list in 2004.

Methylene-di-isocyanate (MDI or Diphenylmethane-4,4'-diisocyanate) is principally employed in the manufacturing of polyurethane foam. Polyurethane products are obtained from polyaddition of diisocyanate and diol components. More in general, diisocyanates are frequently used in the manufacture of indoor materials such as adhesives, coatings, foams and rubbers. In some types of particle board, the diisocyanates have replaced formaldehyde. Diisocyanate monomers (of MDI and HDI) are known as respiratory sensitizers and can cause irritation of eyes, skin and mucous membrane. It may provoke respiratory troubles, sensitization and asthma (WHO 2000). When freshly coated furniture is put into a test chamber, the emissions of HDI can be monitored. Occupational hygiene limit values exist

already many years for MDI and are typically 0.05 mg/m³ (ACGIH – TLV). The German Indoor Air Hygiene Commission did not consider establishment of an indoor air guideline value II for diisocyanates (DI) useful. Despite initial higher concentrations in the air during application of paints and adhesives containing diisocyanates (concentrations within the MAK range), they quickly decrease and long-term exposure is not expected after hardening. As a rule it is stated that the use of products containing DI should take place in well-ventilated rooms.

Permethrin is a biocide used against undesired insects, mainly against mosquitoes. Woollen carpets are often treated with this biocide in order to protect them against moth worms. The information about influence of permethrin on human health is incomplete and often conflicting. The only proven effects are irritations and allergies. Permethrin is also supposed to cause endocrine disruption, effects on reproduction system, and polyneuropathy (WHO, 1990; Cox, 1998); Van Hammée et al., 1999; Wattiez, 1999; NIOSH, 2001). Legislation on permethrin in indoor environments is quasi non-existent. Only the Federal Health Office of Switzerland and "Green Ambulances" in Germany advice the maximum content of 1 mg per kg house dust. As the effects of permethrin on the health and environment are not sufficiently proved by scientific methods, the precautionary principle may be used to limit indoor use of this substance.

Alpha-pinene is used in the manufacture of solvents, perfumes, household cleaning products, and synthetic pine oils. It can provoke irritations of eyes, skin and respiratory tract. Higher concentrations can cause headaches and symptoms of central nervous system. Information on its effects on the health is still incomplete. There are no regulations on alpha-pinene in studied countries. Together with limonene, alpha-pinene was removed from the Finnish list of proposed national priority substances.

Trichloroethylene is a chlorinated solvent mainly used as metal degreasing. Stain removers, rug-cleaning fluids, and correction fluids are other most important indoor sources of trichloroethylene. The substance causes many serious health effects. Liver, kidneys and central nervous system are the target organs for systemic effects. Toxicity on central nervous system, and cancers of kidney, liver and lymphatic system, are the most important effects of trichloroethylene on the health (WHO, 1985; Health Canada, 1993; California EPA, 2001). The IARC classified the substance in group 2A (limited prove of its carcinogenicity to humans, but proven in case of animals). The toxicity of trichloroethylene on human health and on environment has lead many countries to limit its usage. The most often, the regulation concerns a group of chlorinated solvents, i.e. trichloroethylene, tetrachloroethylene, trichloroethane, dichloromethane, etc. Governments have chosen different measures of regulation: total ban in Sweden (concerning only trichloroethylene), tax in Denmark and Norway (several chlorinated solvents), technical requirements concerning emissions (trichloroethylene and tetrachloroethylene).

Triclosan is a commonly used antimicrobial agent in many products including detergents, soaps, toothpastes, deodorants, textiles, shoes, etc. Triclosan is supposed to provoke skin irritation, and contact allergy. Having proprieties of an antibiotic, it may induce appearing of resistant bacteria. Triclosan is a chlorophenol, a class of chemicals which is suspected of causing cancer in humans. It has not been completely tested and analyzed for all health and environmental risks. The Cosmetic, Toiletry and Household Products Association has come to an agreement with its members that they will not use triclosan in high-volume products such as dishwasher liquids and detergents (FORMAS, 2003).

1,2,4-Trimethylbenzene is a widely applied solvent and used in products such as paint related products, foam insulation and wood office products. It appears as ultraviolet stabilizer in plastics. Both the 1,2,4- and the 1,3,5- isomers are toxic by inhalation and by ingestion. They are skin and eye irritants. Both isomers are central nervous system depressants and may cause respiratory disorders, mainly at higher (ppm) concentration levels. The 1,2,4-isomer may also be narcotic. Other effects of exposure to these compounds include headache, tension, nervousness, inflammation and haemorrhaging of mucous membranes, convulsions and ultimately death. The German AgBB has therefore set an LCI value of 1mg/m³. The LCI value represents the lowest concentration of interest measured in a standard emission test chamber. It is chosen so that extrapolations towards model room concentrations are to be considered as below values potentially harmful for human health. Occupational hygiene limit values are in the low ppm level; it means toxicity is estimated as much lower than e.g. benzene and comparable to e.g. toluene.

Toluene is a solvent commonly appearing in many products such as paints, adhesives, aerosols, cleaning products, cosmetics, floor coverings, floor wax, dyes and varnish. It is therefore one of the most abundant VOC's measured in indoor environments. In humans, it provokes effects on central nervous system causing headache, dizziness, irritation. There is also evidence of his developmental neurotoxicity (WHO 1985). Some countries implemented indoor guideline values usually ranging around 300 µg/m³. If higher concentrations occur, actions are suggested. These values are often set from the viewpoint of an individual compound. Therefore, an individual VOC guideline is in most cases combined with a guideline or even an intervention value for TVOC's (total volatile organic compounds). Typical guideline values for TVOC are around 300 µg/m³, while intervention values are either not set or fairly high (e.g.1-3 mg/m³).

Vinyl chloride monomer is used in production of many plastic materials such as window frames, floorings, panelling, wallpapers, furniture, wire and cable coatings. Products made from or containing polyvinyl chloride (PVC), may allow vinyl chloride monomer to seep from new plastic parts. The substance is neuro- and hepatotoxic. It can cause tumours of liver, brain and central nervous system. It is a recognized carcinogen classified in group 1 (IARC).Vinyl chloride illness includes symptoms of central nervous system, Reynaud's fenomenon, hepatosplenomegaly and disturbances of digestive system (Mastrangelo et al., 2004; WHO, 2004; INERIS, 2005). There is very little exposure of general population to vinyl chloride. However, as it is a carcinogenic substance, the risk "zero" does not exist. To limit the exposure to vinyl chloride, the European Commission and Canada prohibit its use in aerosols. Many countries placed restrictions on polyvinyl chloride (the main source of vinyl chloride) in food packaging materials

3.1.4 Priority substances in other countries

Practically every country established its list of substances that should be treated as particularly hazardous. The criteria of choice differ in particular countries. In general, the influence on the human health, and on the environment are the main criteria. In some cases, the protection of the environment is placed on the first position, like in Finland where persistency has been stressed in the selection profile, since it is considered as particularly harmful in the Finnish environmental conditions. Classification of selected substances in some of the priority lists in different countries is presented in Table 2.

Table 2: Presence of selected substances in principal priority substances databases

	Danish EPA	French OIAQ *	Finnish SYKE list	Swedish PRIO	Swedish BASTA **	Ger LCI ***	Calif Chron REL ****
Acetaldehyde	-	X	-	X	X	-	X
Benzene	-	X	-	X	X	-	X
Tetrabromobisphenol A	X	-	-	-	-	-	-
Hexabromocyclododecane	X	-	-	X	-	-	-
Pentabromodiphenyl ether	X	-	-	X	-	-	-
Octabromodiphenyl ether	X	-	-	-	-	-	-
Decabromodiphenyl ether	X	-	-	X	-	-	-
Formaldehyde	X	X	-	X	X	-	X
Certain glycol ethers	X	X	-	X			
Ethyl glycol (EG)			-			X	X
Ethyl glycol acetate (EGMEA)	X		-			X	X
Methyl glycol (EGMM)			-			X	X
Methyl glycol acetate (EGMMA)			-			X	X
Limonene	X	X	-	X	-	X	-
Methylene-di-isocyanate	X	-	-	X	-	-	X
Alpha-pinene	-	X	-	-	-	X	-
Permethrin	-	-	-	-	-	-	-
Toluene	-	X	-	-	-	X	X
Trichloroethylene	X	X	-	X	X	-	X
Triclosan	-	-	-	-	-	-	-
Trimethylbenzene	-	X	-	-	-	X	-
Vinyl chloride	-	-	-	X	X	-	-

* OIAQ - French Observatory of the Indoor Air Quality

** Swedish BASTA system presents the proprieties criteria for selection of priority substances. The substances in the table were selected on the base of these criteria.

*** German LCI list represents the lowest concentration of interest measured in a test chamber (product emission regulation and related to priority substances)

**** Californian (USA) Reference Exposure Level list ; includes outdoor and indoor air quality guidelines (see Appendix 3, California, reference nrs 10 and 12 ; as documents in database Appendix 4)

The lists mentioned in Table 2 have been verified to find a correlation between the 14 Belgian priority substances and the substances mentioned as priority compounds in the other countries. In general, the lists provided by the other countries contain a wide range and much more priority compounds. Here below the number of substances in these lists and the reference where all pollutants are detailed.

- The Danish EPA priority list contains 68 substances and groups of substances. Ref : Danish EPA (2004) List of Undesirable Substances, Environmental Review N° 15, p.76 http://www.mst.dk/homepage/
- In Finland, the proposal for priority list contains 54 industrial chemicals, 17 biocides, and 13 pesticides. In addition, separate lists of eight heavy metals and 37 endocrine disrupters were made. In 2003, the list was revised on the basis of comments received from the industry and other stakeholders. The substances were re-evaluated, and as a result the current proposal comprises 13 industrial chemicals, 6 pesticides and 3 metals. Ref : SYKE (2004) Revision of the proposal for a selection of National Priority Substances in Finland. pp.2 http://www.ymparisto.fi/download.asp?contentid=15662&lan=en
- Swedish lists describe criteria of selection, so it is impossible to give exact number of substances.

- France has listed 70 pollutants: chemical and biological agents. Ref : Personal communication Nathalie Tchilian
- Germany has published the LCI list which contains a total of 168 pollutants. Details are provided in reference: “AgBB 2004. Health-related Evaluation Procedure for Volatile Organic Compounds Emissions (VOC and SVOC) from Building Products”. The LCI list is given on page 12-17 of this reference.
- The Californian CREL (Chronic Reference Exposure Level) list includes 80 pollutants. The complete list on http://www.oehha.org/air/chronic_rels/allChrels.html

3.2 Additional Product Policy to Improve Indoor Air Quality

3.2.1 General view on indoor air politics

Compared to outdoor air and to workplace air, the quality of indoor air has been studied and regulated to a much lesser extent. In spite of growing interest in the quality of indoor air, there are only few countries in the world having set up a legal act specific to indoor air. In most cases, legislations established for other purposes were applied to the indoor environment. The indoor environment however, differs in a large degree from ambient air and from workplaces. First of all, people spend there majority of their time. Persons who are particularly vulnerable to air pollutants (infants, elderly and sick persons) spend also much time in confined spaces. Indoor pollutants are various, and their levels can reach high peak values every day, or high and constant levels through the year.
Different measures are or can be applied to control the quality of indoor environments. These measures are:

- Building Codes;
- Ventilation standards;
- Indoor air quality guidelines;
- Equipment standards and permits;
- Economic measures;
- Technical requirements for production processes;
- Limits on hazardous substances in consumer products;
- Quality requirements for building materials;
- Public awareness raising and information;

Building Codes are legally binding governmental regulations and industry standards or recommended professional practices. They require applying present technical knowledge in construction processes to ensure stable and safe buildings..
The Construction Products Directive (Council Directive 89/106/EEC) regulates the construction products on a European Level. The main goal of the Construction Products Directive is to complete the European internal market for construction products, by supporting the production of harmonised standards and European Technical Approvals. Annex I to the Directive gives the following definition of the essential requirement which is applicable when and where the works are subject to regulations containing such a requirement: "The construction work must be designed and built in such a way that it will not be a threat to the hygiene or health of the occupants or neighbours, in particular as a result of any of the following:

- the giving-off of toxic gas,
- the presence of dangerous particles or gases in the air,

- the emission of dangerous radiation,
- ….

Ventilation standards. A practical and effective approach to ensure good indoor air quality is through adequate ventilation. Ventilation standards ensure that unavoidable emissions or effluents (e.g. bi-effluents and CO_2 from the occupants) are sufficiently diluted.
The European Directive on the energy performance of buildings (2002/91/EC) defines a number of elements important for designing energy respecting buildings. The directive also includes ventilation aspects expressed as maximal level of carbon dioxide
Indoor air quality guidelines in dwellings play a different role than limit values established for ambient air or workplaces. As dwellings are private spaces, controls of quality may not be imposed. On the other hand, they can be useful in case of looking for elements causing health disturbances by e.g. "green ambulances".
Equipment standards and permits. Many indoor risks can be managed by setting standards for the design and performance of equipment, which might contaminate indoor air (e.g. combustion devices for heating and cooking), as well as for their installation and evacuation of produced pollutants.
Economic measures, mainly taxes on certain toxic substances, aim to reduce usage of these substances in products. This measure is usually used to hasten manufacturers' efforts to replace dangerous substances with less dangerous alternatives.
Technical requirements for production processes are usually used to limit dispersion of toxic substances into the environment. They limit also the usage of these substances and can reduce their content in final products.
Limits on hazardous substances in consumer products. Materials and products used indoors are the main sources of different pollutants. Legally mandated bans on the use of defined toxic compounds, concentration or emission limit values for products used for construction and furnishing buildings and for consumer products used in buildings can ensure that non-necessary exposures are avoided.
Quality requirements for building materials. Using good quality materials and products in construction ensures good quality indoor environments. Quality requirements can be legally binding requirements or voluntary agreement of producers. The first option permits controlling all materials, but can appear limiting for industrial and technical development. Voluntary actions, together with adequate information of the public, incite improving the quality of different products and can give faster results than governmental legislation.
Public awareness raising and information. Most indoor risks must be managed by the occupants themselves. Such actions can be possible only if the population receives adequate, comprehensible and sufficiently detailed information on the nature of risks associated to presence of certain pollutants in indoor environment, and possible actions to avoid exposition or to improve indoor air quality.

3.2.2 National Policy Measures taken to Improve Indoor Air Quality

Building Codes

The indoor environment legislation is often based on Building Acts. These Building Acts contain general recommendations stating that buildings shouldn't constitute a detriment to human health or the environment. They are often framework laws, which means that they do not specify limit values. The recommendations are indefinite, and can be interpreted in different ways; they simply inform that buildings should be constructed in a way to avoid any health problems.

- In almost all European countries, requirements and guidelines exist for the design and construction of new buildings. Such activities need a building permit issued by local authorities. The main emphasis in these requirements is the stability and fire resistance of the construction, but in many countries energy economy, protection against noise, protection against moisture, sanitary and hygienic conditions, as well as prerequisites for good indoor climate are also included.

The National Building Code of Finland, besides general statement not to cause discomfort to occupants of buildings, contains also more precise information. It requires that the indoor air does not contain any gases, particles or microbes in such quantities that will be harmful to health, or any odours that would reduce comfort. It gives the maximum permissible values for indoor environments of several gases, chemical substances and particles. These substances and their guideline values are presented in Table 3. The maximum concentrations of other impurities not enumerated in the Code shall not exceed 1/10 of the occupational exposure limits.

Table 3: Values for concentrations of impurities in indoor air for the purpose of designing and implementing indoor climate of buildings (from Indoor Climate and Ventilation of Buildings Regulations and Guidelines, National Building Code of Finland, 2003)

Substance	Maximum allowed concentration
Carbon dioxide	2 160 mg/m³ (1200 ppm)
Ammonia and amines	20 µg/m³
Asbestos	0 fibres /cm³
Formaldehyde	50 µg/m³
Carbon monoxide	8 mg/m³
Particles PM10	50 µg/m³
Radon	200 Bq/m³
Styrene	1 µg/m³

The Environmental Code of Sweden, adopted in 1999, states that any disturbance liable to produce adverse effects on health in medical or hygienic terms should be avoided. Detrimental effects include heat, cold, draughts, humidity, noise, air pollutants, radon and fungal damage. Residential buildings must provide adequate protection, and maintain an adequate standard of hygiene. There are neither limit values nor guidelines for indoor air quality in the Environmental Code. Also requirements concerning construction products are very general, stating for example that construction products shall be suitable for their intended use.

One of the major German programs to improve indoor air quality tries to reduce the emissions of dangerous substances from building products. This program is coordinated through the *"Ausschuss zur gesundheitlichen Bewertung von Bauprodukten"(AgBB-Committee for Health-related Evaluation of Building Products)*. The work of the AgBB is based on data of the *European Collaborative Action (ECA) "Indoor Air Quality and its impact on Man" (ECA Report nr. 18)* To achieve it's goal, the AgBB has developed a procedural scheme to evaluate the VOC-emissions from building products used for indoor applications (AgBB, 2004). At present, the applicability is under discussion with the involved parties. Briefly, the scheme consists of two steps. The first step is an emission test after three days, where TVOC concentrations and the sum of detected carcinogens are assessed. An emission test after 28 days is the second step. Emissions of TVOC, SVOC, the

sum of detected carcinogens, individual compounds with an associated LCI-value and the sum of all individual compounds without associated LCI value (Lowest Concentration of Interest) are successively assessed. The German Institute for Civil Engineering (*Deutschen Instituts für Bautechnik – DIBt)* has implemented the AgBB scheme for the first time in August 2004 in the permission procedures for floor covering and floor covering adhesives. (601 textile floor covering, 602 resilient floor covering, 603 PVC – floor covering, 604 linoleum – floor covering, 605 floor coating, 606 parquet/laminate floor covering, 608 polyurethane – floor covering, 609 polyolefin – floor covering). It means that products of these types are only admitted on the German market when they successfully pass all criteria of the evaluation scheme

The Construction Products Directive (Council Directive 89/106/EEC) is converted into German national laws with the "*Bauproduktengesetz"* (BauPG-1992-08-10, Building Products Act). The German Building Products Act regulates how the Construction Products Directive, concerning the market introduction of building products, has been laid down in accordance with the German Model Building Code (*Musterbauordnung*) and the Building Codes of the States based to the latter.
Two sections of the German Model Building Code (*Munsterbauordnung)* are dedicated to health- and environmental requirements: Section 3: *Buildings must be designed, constructed and maintained in such a way that the public security and order, particularly life, health and the natural life conditions shall not be endangered.* Section 13: *Buildings must be designed and fit for use in such a way that due to water, dampness, herbal or beastie varmints as well as other chemical, physical or biological impacts hazards or unacceptable nuisance shall not result.*

The Californian Department of General Services specified that all governmental building projects should include sustainable building measurements. The minimal requirements are listed in Section 01350, Special Environmental Requirements, which provided protocols for testing of emissions of VOCs from building materials and furnishings to protect human health in state buildings. A guide is available from the Department of Health Services that updates the indoor air quality portions of Section 01350. The guide states that the emissions factors calculated from the small chamber tests for each of the identified chemicals of concern are to be used to calculate the "modelled" indoor air concentrations for a standard office space or a classroom application using default ventilation rates, quantities (surface area, fault length, or units) of the material to be installed, and space volumes. Section 01350 requires that modelled indoor air concentrations of any chemical 96-hours after the 10-day conditioning period, may not exceed half of the Californian Chronic Reference Exposure Levels with the exception of formaldehyde. For formaldehyde, no single product's modelled concentration can contribute more than half of the total maximum 33µg/m³ (27 ppb) concentration limit for this chemical.

Ventilation standards
Every country has fixed minimum values of ventilation that depend on the surface of the room, its occupation, and destination. In this way, different ventilation rates will be demanded for a living room than for a kitchen, a bathroom or a classroom. As a general rule, the outdoor air flow rate should be at least 0.35 L/s per m^2 which corresponds to an air change rate of 0.5 L/h in a room with a free height of 2.5 m (Sweden, Finland, Poland).

Indoor air quality guidelines/Limit Values

The indoor climate is a rather new topic in respect of legislation, and it is also an area with very limited regulation. In fact, one of the greatest difficulties in establishing indoor climate legislation is the limited knowledge on the effects of chemical pollutants on human organism in low doses combined with exceedingly large number of substances found in indoor environments. In consequence, indoor climate legislations or recommendations exist for only few, mostly studied pollutants. The limit values for indoor air concentrations were fixed in different countries for formaldehyde, radon, carbon monoxide, carbon dioxide (used as ventilation sufficiency indicator), and asbestos. Additionally, Finland used existing legislation for workplace environments, and stated that the maximum concentrations of other impurities not enumerated in the Code shall not exceed 1/10 of the occupational exposure limits.

Quite interesting approach to indoor air guidelines is that of Poland. The regulation, rather unique in Europe and in the world, fixes the maximum allowable concentrations of harmful substances for two categories of rooms. Category A covers rooms designated for living, rooms designated for occupation by patients in health care buildings, and rooms for occupation by children in educational buildings. Rooms designated for occupation in public utility buildings, as well as auxiliary spaces in dwellings should meet criteria for category B. The limit values for these two categories were fixed for 35 substances (Appendix 3, Poland –Table 11).

In Germany, it was the Indoor Air Hygiene Commission (IRK) that established official limit values for indoor environments. There are two limit values: *Richtwerte I (RW I)*, and *Richtwerte II (RW II)*, where the latter one is derived from *Richtwerte I* by adding a factor (usually being 10). Guide value I (RW I) is the concentration of a substance in indoor air for which, when considered individually, there is no evidence at present that even life-long exposure is expected to cause any adverse health impacts. Values exceeding this are associated with a higher-than-average exposure that is undesirable for health reasons. At present, RW's are already established for eleven pollutants (Table 4). To take mixtures of different pollutants into account, rather then with concentrations for single pollutants, there are also values for TVOC given. The working group did not consider establishment of a RW II value for di-isocyanates (DI) useful, because they quickly decrease and long-term exposure is not expected after hardening.

Table 4: Guideline Values for Indoor Air (RW, Germany)

Compounds	RW II (mg/m$^{3)}$	RW I (mg/m$^{3)}$	Year of Implementation
Toluene	3	0.3	1996
Dichloromethane	2 (24 h)	0.2	1997
Carbon monoxide	60 (1/2 h)	6 (1/2 h)	1997
	15 (8 h)	1.5 (8 h)	
Pentachlorophenol	1 µg/m^3	0.1 µg/m^3	1997
Nitrogen dioxide	0.35 (1/2 h)	-	1998
	0.06 (1 Week)		
Styrene	0.3	0.03	1998
Mercury (as metallic vapour)	0.35 µg/m^3	0.035 µg/m^3	1999
Tris(2-chloroethyl)phosphate	0.05	0.005	2002
Bicyclic terpenes (principal constituent alfa-pinene)	2	0.2	2003
Naphthalene	0.02	0.002	2004
Aromatic hydrocarbon mixtures (C9-C14)	2	0.2	2005

Canada has made a step forwards by editing a document especially prepared for indoor environments. “Exposure Guidelines for Residential Indoor Air Quality” were edited in 1997 by the Ministry of the Health of Canada (Health Canada). The document gives the limit values of exposure for following substances: aldehydes, formaldehyde, carbon dioxide, carbon monoxide, nitrogen dioxide, sulphur dioxide, ozone, radon, particles, and water vapour. Biological agents, pesticides, lead, hydrocarbons and chlorinated solvents were classified as substances for which exact limit values could not be fixed. Recommendations how to avoid or limit exposure to these substances are however detailed in the document.

The utility of such documents can be discussed. Fixed guidelines and limit values are a good base to evaluate the quality of indoor air. Of course, they should be regularly reviewed and adapted to the latest scientific knowledge. However, the guidelines alone will not improve the air quality. Adequate tools are necessary to reduce concentrations of pollutants, and to limit their emissions from different materials.

In the United States – State of California, the OEHHA has developed an 8-hour, interim indoor REL (IREL) for formaldehyde of 27 ppb, specifically for indoor application.
This IREL identifies the level below which effects such as eye, nose, and throat irritation would not be expected to occur during typical daytime (8-hour) occupancy of buildings.
Several bodies of the United States of America’s Federal government have published guides for informing, and improving indoor air. Examples are:

- EPA: *The inside Story: a Guide to Indoor Air Quality”;*
- CPSC: *Indoor Air Pollution: Introduction for Health Professionals;*
- HUD: *Help Yourself To a Healthy Home - Protect Your Children's Health*

There are also several websites operated e.g. EPA (http://www.epa.gov/iaq/ia-intro.html) or USDA (http://www.csrees.usda.gov/ProgView.cfm?prnum=4356). The U.S. EPA provides information on Healthy School Environments on a website, covering a broad range of topics, including indoor air quality.
In the state of California, the main report is the Air Resource Boards (ARB) report about Indoor Air Quality (ARB, 2005). The ARB also operates a web portal with indoor air quality guidelines for the general public. Currently, three indoor air quality guidelines have been published: formaldehyde, combustion pollutants and chlorinated hydrocarbons. The Division of Environmental and Occupational Disease Control has in addition it’s portal of the California Indoor Air Quality Program.

Equipment standards and permits

Equipment standards and permits concern mainly combustion devices for heating and cooking. These standards are well implemented in every country. As the usage of these appliances may change their performances, regular maintenance and quality verification is legally regulated. This measure is strengthened by setting special training and certification requirements for the personnel who inspects, maintains, or in some cases operates the equipment.

Economic measures

Taxes or green taxes are most often used economic measures aiming to improve the quality of the environment. Taxes were used in some countries to reduce usage of chlorinated solvent. Denmark and Norway implemented taxes on most dangerous often used chlorinated solvents: trichloroethylene, tetrachloroethylene and dichloromethane. In both cases, the use of these substances has been drastically reduced, with, for example, 60 %-drop in consumption over three years in Denmark.

Technical requirements for production processes
Very limited information was found on application of technical requirements aiming to reduce the quantity of used toxic substances. The only available example is the one of Germany that employed tough technical requirements concerning emissions of chlorinated solvents during manufacture processing. This measure resulted in remarkable drop of the usage of the substances.

Limits on hazardous substances in consumer products
National legislations rarely regulate content of chemical substances in construction products. In general, they recommend using products that do not provoke undesirable health effects, without specifying which substances should be taken into consideration. Danish Building Regulations give some more information by recommending the use of building materials which are under Danish Indoor Climate Labelling scheme or materials which can be accepted under the scheme.

Besides formaldehyde that is regulated in most countries (as well its concentrations in indoor air, as its content or emission from building materials),
Poland is nearly the only country restricting the usage of other substances in building products (WHO, 1999). The Polish Regulation sets restrictions (in many cases prohibition) as for content in building materials for 17 substances. Paradoxically, formaldehyde is not included in the list (Table 12 in information about Poland in Appendix).

The U.S. Department of Housing and Urban Development (HUD) has set limits for formaldehyde emissions from plywood and particleboard used in mobile homes in 1984. Test chamber concentrations are not to exceed 0.2 ppm and 0.3 ppm, respectively, to maintain indoor air concentrations of formaldehyde in mobile homes below 0.4 ppm [24 CFR 3280.308].

In Germany, the Chemicals Prohibition Act regulates 27 pollutants among which organotin chemicals, pentachlorophenol e.d. (*Chemikalien-Verbotsverordnung*" (ChemverbotsV – *Chemicals Prohibition Act).* Pollutants, listed being carcinogenic can not be used intentionally. A comprehensive overview was presented by W. Misch at the BRE workshop (slides in database, Appendix 4).

In the United States of America, the Consumer Product Safety Commission is charged with protecting the public from unreasonable risks of serious injury or death from consumer products. In the State of California, this policy is strengthened by the Air Resources board. The latter has prohibited the use of several toxic air contaminants in 13 categories of products. At present, regulations exist for antiperspirants, deodorants, consumer products, aerosol coatings and hairsprays (17 CCR s 94502/17 CCR s 94509/17 CCR s 94522)
The Toxic Substances Control Act (TSCA) of 1976 was enacted by the United States Congress to give EPA the ability to track the 75,000 industrial chemicals currently produced or imported into the United States. EPA repeatedly screens these chemicals and can require reporting or testing of those that may pose an environmental or human-health hazard. EPA can ban the manufacture and import of those chemicals that pose an unreasonable risk. TSCA's most recent amendments have provided specific emphasis on asbestos, indoor radon, and lead-based paint exposure. TSCA supplements other federal statutes, including the Clean Air Act and the Toxic Release Inventory under EPCRA (Emergency Planning and Community Right-to-Know Act).

In the United States, Federal law requires that before selling or distributing a pesticide, a person or company (registrant) must obtain registration, or license, from the U.S. EPA. Before registering a new pesticide, the U.S. EPA must first ensure that the pesticide, when used according to label directions, can be used with a reasonable certainty of no harm to human health and without posing unreasonable risks to the environment.
The Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) requires that the Californian Governor revises and republishes at least annually the list of chemicals known to the State to cause cancer or reproductive toxicity. Businesses are required to provide a "clear and reasonable" warning when their products or actions may result in a release of chemicals above a specified threshold level, so that members of the public are aware they may be exposed to harmful chemicals.

Quality requirements for building materials
Quality requirements for building materials can have big influence on the quality of indoor environments. They can be legally binding requirements or voluntary agreements of manufacturers. Labelling systems are the best known and most popular mean to ensure good quality materials.
The labels are particularly popular in Nordic countries and in Germany. Finnish Classification of Indoor Climate, Construction, and Finishing Materials is a quite complete and interesting system because it relates the required quality of materials to the indoor quality guidelines. In practice, the requirements for building materials are established in emission test rooms in a way that the materials should not increase concentrations of selected substances over established limit. The requirements are calculated for typical indoor environments.

In Germany, products not tested according to the German Model Building Code, can only be introduced onto the German marked on condition that they can be used under the Construction Products Act or under the regulations of other EU-member states based on the Construction Products Directive or other EU – guidelines (on the condition that these regulations consider the essential requirements) and have a CE-mark based on the Construction Products Directive. The CE-mark also needs to show the German classes and the performance level for the product in question.

Quite interesting legislative requirements concerning building materials exist in Polish legislation. The National Institute of Hygiene and Epidemiology was designed to analyse all building materials from the health point of view. All new products and materials have to receive the national attest to be allowed for sale. The permission is needed for domestic and imported products. Every year, about 2000 materials are evaluated based on legal regulations issued by the Minister of Building and Building Materials.

3.3 Voluntary Actions

3.3.1 Guides Concerning Indoor Air Quality

An important instrument for the improvement of indoor air quality is to raise public awareness. Persons that are well informed can better protect themselves against harmful influence of certain substances present indoors. They can also influence the market by choosing low emitting products or avoiding purchase of products containing toxic substances. The United States and Canada are the leaders in this matter. They have

published many guides that inform about potential dangers related to indoor air pollution, and explain methods to improve the quality of the air. Special guides, intended for the general population are written in a simple and understandable language; technical handbooks are addressed to professionals. Many of the guides and handbooks can be consulted online. An interesting example is:

- HUD: *Help Yourself To a Healthy Home - Protect Your Children's Health*

Other examples are available on the previously already mentioned websites like e.g. EPA (http://www.epa.gov/iaq/ia-intro.html). The U.S. EPA provides also information on Healthy School Environments on a website, covering a broad range of topics, including indoor air quality.

In 1992,in the context of spreading information and further public awareness, the German Federal Government published it's first *"Konzeption zu Vebesserung der Luftqualität in Innenräumen" (Concept to Improve Indoor Air Quality)*. This concept contained 13 main points where should be focused on:

- Bauprodukte – Construction Products;
- Ausstattungsmaterialien und Einrichtungsgegenstände - Furnishing materials and furnishings;
- Offene Flammen, Feuerstätten und Außenwandfeuerstätten - Open flames, fire places and external wall fire places;
- Raumlufttechnische Anlagen (RLT-Anlagen) - Ventilation equipment;
- Radon – Radon;
- Einfluss der Umgebung (Altlasten-Standorte, Straßenverkehr, gewerbliche Anlagen u.a.) – Environmental Influence (e.g. Dumps, Traffic, Industrial Plants)
- Putz-, Reinigungs- und Pflegemittel - Finery-, Cleaning- and Preservative agents;
- Mittel zur Ungezieferbekämpfung und Desinfektion von Holz-, Textilschutz sowie zum Schutz vor Zimmerpflanzen - Products for vermin control and disinfection of wood, textile protection and to protect houseplants;
- Gebrauchsartikel und Produkte des Heimwerker-, Hobby- und Bastelbereichs - Consumer products and products for do-it-yourselfers-, hobby- and tinkering area;
- Tabakrauch – Tobacco Smoke;
- Hausstaub, Mikroorganismen und allergisierende Stoffe – House Dust, Micro Organisms and Allergens;
- Unsachgemäße Anwendung chemischer Stoffe und Produkte in Innenräumen - Inappropriate application of chemical materials and products in interiors;
- Luftverunreinigungen in Fahrzeuginnenräumen - Air Pollution in vehicle Cabins.

In 2004, a follow up report was compiled *"Verbesserung der Luftqualität in Innenräumen – Ausgewählte Handlungsschwerpunkte aus Sicht BMU" (Improvement of Indoor Air Quality – Selected Main Points of Action from the Angle of BMU).*

At present, questions about healthy Indoor Environment are managed in the framework of the action program Environment and Health ("Aktionsprogramms „Umwelt und Gesundheit" - APUG). The program is developed by the Federal Ministry of Environment and the Federal Ministry of Health.

The German Environmental Ministry has also published several guides to increase the awareness of the general public. Interesting examples are: the mould guidelines (*"Hilfe Schimmel im Haus")*, black soot deposition (*"Attacke des schwarzen Staubes"),* Indoor Air Quality in Schools (*"Leitfaden für die Innenraumlufthygiene in Schülgebäuden"*), Products for wood protection (*"Verbraucherleitfaden Holzschutzmittel"),* a general leaflet about healthy housing (*"Gesünder wohnen – aber wie? Praktische Tipps für den Alltag"*). These documents can be consulted online (UBA or APUG).

3.3.2 Databases of substances

Governments of many countries established databases of dangerous or potentially dangerous substances. The aim of the databases is to reduce risks linked to the usage of chemical substances. Some of the lists, for example the Swedish "Restricted Substances Database", contain substances that are regulated by national legislation. The restricted substances database is a tool for finding out about legislation relating to individual substances. A small number of substances are completely banned. Many substances are merely regulated in a particular application.
Most of the databases contain substances that may cause adverse effects to human health or to environment. These lists inform about a potential danger from using certain substances, for which there is no national or international regulation. In this sense, they do not regulate the substances but warn about a possible regulation in the future. The Finnish Environment Institute proposed that the persistent, toxic and tend to bioaccumulate (PBT) substances should be on the priority list of hazardous substances. Persistency has been stressed in the selection profile, since it is considered as a particularly harmful character in the Finnish environmental conditions. The selection mechanism has focussed on the environmental hazard, but most of the selected chemicals are of concern for the human health as well. Persistency, bioaccumulation, toxicity and carcinogenicity are also the main criteria used in the priority lists in Sweden and Denmark.
Lists of undesirable substances can also be initiated by industries, as it is the case of BASTA system in Sweden. The substance properties are based on the plans in the forthcoming REACH regulation, plus the phase-out substances identified by the Swedish Parliament, lead, cadmium and mercury. The properties criteria mean that products must not contain chemical substances (above stated concentrations) with the following properties:

- carcinogenic substances;
- mutagenic substances;
- substances toxic to reproduction;
- persistent or very persistent substances;
- bioaccumulative or very bioaccumulative substances;
- endocrine disruptors;
- sensitising substances;
- toxic and very toxic by inhalation, skin contact and/or if swallowed;
- certain volatile organic compounds, for example solvents.

These properties criteria are applicable to all types of construction products and apply to their properties on delivery to a construction site. They are stricter than the Swedish legislation and have been geared towards reducing the use of substances with particularly hazardous properties

All the non-mandatory lists include chemical substances, which are not banned but which are not desired in products, as they are considered to have a particularly severe impact on the health and environment. They warn enterprises, importers, product developers and buyers of the substances for which they should be seeking alternatives, as it may be expected that the authorities will start to prohibit and/or regulate these substances in other ways. The list may help to evaluate the hazard potential of chemicals and also to support the substitution principle.
The serious problem of this method is the lack of data. Only about 900 chemicals registered in the Finnish Register of Chemical Products (KETU) have information on persistency, toxicity and bioaccumulation, and can potentially be selected as priority chemicals. More

than 4500 chemicals remain outside the selection. A possibility that dangerous substance are not included in the list remains quite high. The general character of these lists shall allow relatively easy adaptations and additions of new substances.

The German Environmental Ministry, for instance, operates a database containing low emitting products (http://www.umweltbundesamt.de/voc/). The German Federal Institute for Risk Assessment provides information and has several databases on chemicals and related product policy. (http://www.bfr.bund.de/cd/template/index_en)

The USA National Toxicology Program (NTP) was established in 1978. The program was created as a cooperative effort to: coordinate toxicology testing programs within the federal government, strengthen the science base in toxicology, develop and validate improved testing methods, provide information about potentially toxic chemicals to health, regulatory, and research agencies, scientific and medical communities, and the public. One of the documents published is the Report on Carcinogens (RoC).
The RoC is an informational scientific and public health document first ordered by Congress in 1978 that identifies and discusses agents, substances, mixtures, or exposure circumstances that may pose a hazard to human health by virtue of their carcinogenicity. The RoC is published biennially and serves as a meaningful and useful compilation of data on:

- The carcinogenicity (ability to cause cancer), genotoxicity (ability to damage genes), and biologic mechanisms (modes of action in the body) of the listed substance in humans and/or animals.
- The potential for human exposure to these substances.
- Federal regulations to limit exposures.

The current RoC contains information about 245 substances.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) section 104 (i), as amended by the Superfund Amendments and Reauthorization Act (SARA), requires ATSDR (Agency for Toxic Substances and Disease Registry) and the EPA to prepare a list, in order of priority, of substances that are most commonly found at facilities of the National Priorities List (NPL) and which are determined to pose the most significant potential threat to human health due to their known or suspected toxicity and potential for human exposure at these NPL sites.

The Collaborative for High Performance Schools publishes a list of products that reach section 01350 product emission requirements.

The California Department of the State Architect has started an online database of building products that are environmentally preferable products (EPP) for school construction. (http://www.eppbuildingproducts.org). The database can be consulted at no cost, but the present status is unclear (postponed?). Twenty categories of products are included in the database, four categories have been consulted and commented by stakeholders (e.g. public, industry,…)

3.3.3 Labelling systems

There are several labelling systems in European countries.
Rather than specifying guidelines or even target levels for indoor air, manufacturers have a tendency to concentrate on the quality of their own products. If they care about the indoor

environment, they define product-specific emission rates for selected compounds. Therefore, regulations concerning emission rates of specific substances can be better accepted.

For about 22 product groups, the CE-marking is available. CE marking symbolises conformity to all the obligations incumbent on manufacturers for the product by virtue of the Community directives providing for its affixing. When affixed to products it is a declaration by the natural or legal person having affixed or been responsible for the affixing of CE marking that the product conforms to all applicable provisions, and that it has been subject to the appropriate conformity assessment procedures. Hence, Member States are not allowed to restrict the placing on the market and putting into service of CE marked products, unless such measures can be justified on the basis of evidence of the noncompliance of the product

One of the best known labelling systems is the Finnish "Classification of Indoor Climate, Construction, and Finishing Materials" introduced in 1995. The system was initiated by the scientific community, and founded by the Finnish Ministry of Environment as a voluntary scheme supplementing building codes. The guidelines include measurable target values, cleanliness requirements and emission criteria for building materials. At the beginning, the classification was aimed only for finishing materials, but since 2001, all construction materials can apply for the emission classification. Over 880 products fabricated by more than 110 producers now reach the low-polluting criteria (class M1), which makes approximately 20 % of all available materials.
At present, the system is independent from the industry and from the government. The government supported creating the labelling system, but didn't make publicity. In fact, the public was already aware of problems linked to indoor pollution (Jorma Säteri, personal communication).
A special guide was created to encourage healthier and more comfortable buildings. This guide describes three classes of building materials based on their total emissions of VOCs, formaldehyde and ammonia. To have healthier buildings, materials must be chosen from the lowest emission class (FISIAQ, 2001).
The classification of the indoor air quality and materials according to their harmful emissions has been used now for nearly 10 years. The system has proven to function well in practice. Buildings built with the best category S1 materials have also better air quality compared with buildings where non-classified materials were used (Tuomainen et al, 2001). Since the classification was initiated, the manufacturers and importers of construction materials have improved the quality of their product so much that the measured emissions have decreased by a factor of thousand or more in some cases. Many domestic and foreign firms have developed new, low emission products by using improved technology, cleaner receipts, and laying more emphasis on product quality control.
This development and production of less emitting materials has also proved to be economically profitable. Although production of better quality materials may require some extra cost, it is limited and negligible when compared with the life-cycle costs, and especially with the advantages better indoor quality gives to the users of the building. As soon as the manufacturers have realized that the extra costs are limited in comparison with advantages in the marketing of their products, they started to take an active part in the system (Kukkonen, 2003).
The labelling system in Finland is efficient because it is regarded as incitation of development, and a good indoor policy should promote development. Setting of targets is also important: it seems better to establish good and very good quality criteria, not only

minimum emission admissible. The idea to have three different levels of labels is not contradictory, and at the same time incites producers to improve their products.
At present, office buildings in Finland are built in good quality materials even if there is neither obligation nor recommendation to choose labelled materials for these buildings. The indoor air quality and material classification in Finland has shown that private voluntary action of the industry can help in improving the indoor air quality in buildings. Such actions can help to avoid unnecessary regulations. The Government cooperation and support is however important.

Voluntary labelling systems are also common in Sweden. The initiative for labels came from Non-Governmental Organisations. There are several label systems used for different products or for specific groups of persons, e.g. unperfumed soaps and laundry detergents for allergic persons. The label of the Asthma and Allergy Association recommends the product, but does not inform about the product's environmental characteristics.

A Nordic certification program of labelling known as the Nord Swan was created in the goal to reduce the consumer burden on the environment. The label is voluntary and neutral. It is intended to provide consumers with guidance in choosing products least hazardous to the environment, to stimulate manufacturers to develop products and processes that are better for the environment, and to use market as a complement to environmental legislation. More than 3,000 products, mainly household chemicals, paper products, office machinery and building materials, have earned the label (Swan Label, 2004). The program is applied in Norway, Sweden, Denmark, Finland and Iceland. The program's agency in Norway is administered as a foundation, while the Swedish, Finnish and Danish agencies are incorporated into their national standardization organizations.
The criteria for the label take into account environmental factors throughout the product's life cycle from raw material, production and distribution, during use and as refuse. Several most important parameters are evaluated: consumption of natural resources and energy, emissions into air, water and soil, as well as generation of waste and noise. Criteria are precise and measurable, and are generally based on existing standards, so there is no doubt the product is legitimate. The label is usually valid for three years, after which the criteria are revised and the company must reapply for a licence.
In 1998, a survey showed that more than 80 % of Norwegian customers prefer products with the Swan label. Products bearing the Swan logo are purchased at both the corporate and government level. Many companies and national and local governments have a purchasing policy requiring that products they purchase are labelled with the Swan or its equivalent.

Consumers in the Nordic countries and Germany consider their eco-labels to be equivalent to a mark of basic quality, and their purchasing decisions are often based on them. Where an eco-label "black lists" a product – as in the case of BFR in electronic products – this can quickly create the perception that these products are in any event banned, or at the very least will be banned soon. Thus, an apparently voluntary scheme is easily transformed into an obligation.

In Germany, several private labels are available; the manufacturers can use these to prove the quality of products. Examples are the natureplus label (AGÖF), Emicode (GEV) or GUT (Gemeinschaft umweltfreundlicher Teppichboden e. V).

In the United States, labels for low emissions of e.g. formaldehyde are being developed and sustained by e.g. the Hardwood Plywood and veneer Association. The Carpet and Rug

Institute (CRI) has developed a new label (Green Label Plus) which demonstrates compliance with the Californian Section 01350 requirements. Under the Green label plus, emissions of formaldehyde from carpets shall cause lower model chamber concentrations then 16 µg/m³ and 2.5 µg/m³ for 4-Phenylcyclohexene.
The Greenguard Environmental Institute has certification programs that prove low emission for about 2000 substances, including formaldehyde, the NTP list et al.

In California, Green Seal is developing standards to reduce emissions. Currently, they are focussing on governments (all levels) to use products wearing there label. One standard (GS-36) specifies e.g. that known carcinogens shall not exceed 0.1 % of the product mass.

Another action taken in the private field, worth noticing, is the vehicle interior environment quality certification, initiated by Ford. The label is intended to replace all existing labels that are in use for vehicle interiors at present.

Regarding labelling systems, there is an ECA report in preparation that provides an overview of all existing European emission labelling systems (ECA WG "Report on Harmonisation of indoor material emission labelling systems in EU" – part A).

3.4 Subjects of Interest

The goal of the project was not only to gather information on the policy measures in use in different countries of interest. Several subjects of interest were taken down in the specifications of the project. Insofar not yet covered in the preceding items, short examples will be provided to indicate how other countries have dealt with specific questions/topics that were raised.

The prioritisation of pollutants to be taken in account for product policy differs in each country, but is always based on toxicology data. In European countries, the starting point is European legislation/research. A research program has been initiated by the Joint Research Centre to cover this topic (Kotzias et al. 2005).

Some lists use the criteria identified also in the forthcoming REACH regulation, e.g. the Swedish PRIO database, and BASTA system list. The PRIO database was settled by the National Chemicals Inspectorate (KEMI). It contains substances that are regulated, and those that are not covered by any legislation but are of high concern. The properties criteria reflect the criteria fixed by REACH regulation. The BASTA system is a voluntary agreement of the construction sector on a common definition of substances' properties as to whether a product is to be accepted or not. Adopting the same criteria as in REACH should help industry to be better prepared for the new European regulation, and to have enough time for all necessary modifications of production procedures.

Certain lists give only criteria and referred documents to classify substances, whereas other priority lists give names of particular substances or their families. In the first case, the list does not have to be modified if new harmful proprieties of not classified substances are detected. However, before the substance enters into the priority list, the referred document has to be adapted. The choice will depend on possibility and facility to modify all kind of related documents. It should be also mentioned that in some cases, e.g. Swedish BASTA

system, it is not easy to verify if a substance is the priority one or not. The property criteria are very well described in English whereas the database is available only in Swedish.

The priority lists are regularly verified, as this is the case of the Finnish Proposed National Priority Substances. In 2000, for example, the list contained the family of terpenes, but these substances were excluded from the list in 2004.

France opted for a different approach to select substances of particular interest. The substances were selected on the base of results of a national survey on indoor quality in dwellings. About 700 dwelling were investigated for different kinds of contaminants, and the most often detected were used to establish a list of 70 prioritising pollutants. The list is not limited to chemical substances; it includes biological and physical factors as well.

In California, there were two additional view points. One was to investigate which levels of certain pollutants are found indoors, and to compare that with toxicology data to assess how harmful these concentrations are. (Hodgson & Levin, 2003). Another point of view might be the economic cost that the pollutant causes. In the Californian Report about Indoor Air Quality (ARB 2005), it is stated that the combined cost of both fatal and non-fatal impacts due to indoor air pollution in Californian homes, schools, and non-industrial workplaces is substantial; and it is estimated at $45 billion per year.

Not all the fourteen substances selected for the present project are on priority lists of different countries. On the other hand, these lists contain other pollutants of different proprieties and origins. The most often additionally included substances are: acrylamide, certain phthalates, several chlorinated solvents and three metals (lead, cadmium, mercury)

Ammonia is a substance of particular concern in Finland. It is not on the Finnish priority list, which was established in purpose to protect the environment, but it is regulated by the Classification of Indoor Climate, Construction, and Finishing Materials. Ammonia was detected in many Finnish houses in high concentrations, and it was often responsible for health and comfort disturbances. In fact, this substance is emitted from many household cleaning products, and it can also be emitted by building materials when they are in humid conditions.

The ARB (USA) also regulates consumer products, for the purpose of reducing smog in California. An additional benefit is a reduction in the amount of certain types of VOCs that are released in homes and institutions. Ambient regulations for ozone, also improves the indoor air quality since outdoor ozone is the main source for indoor ozone exposure.

The concentrations, for a majority of substances, are higher indoors than in ambient air. For this reason, the outdoor air does not make a danger for indoor air quality, and ventilation is generally recommended to evacuate contaminants. However, some substances present outdoors can, in particular situations, enter inside buildings and provoke some disturbances. Ozone is an example of such a substance: in particular atmospheric conditions, its concentrations are very high. Once inside, ozone can react with certain terpenes often present inside buildings, and cause formation of unidentified strong upper airway irritants.

However, neither in Germany, nor in the United States of America, the use of ambient air quality standards, or workplace exposure standards is favoured to be used indoors. In the United States, those standards (workplace) are designed for 8-hour exposures of healthy

adults; they are not as protective as standards set for ambient air, and are not designed to protect the more sensitive subgroups of the population, such as children. In the absence of indoor air quality standards or guidelines, the ambient air quality standards serve as useful guideline levels for those pollutants indoors, because they are based on specified averaging times and incorporate a margin of safety.

When preparing legislation regulating usage of chemical substances, special attention should be paid on possibilities to replace them by others, less dangerous compounds. A good knowledge on the proprieties of the substances, the possibility to use them in particular products, their compatibility with other components of finished products, the technology of production, etc. is essential in taking the decision on substitution.
There is a large number of non-halogen compounds that can be used as substitutes for brominated flame retardants. They belong to different families of chemicals among which organic phosphorus compounds, inorganic compounds, and nitrogen containing substances (as the three main groups). Many of them are considered as low toxic, but the information available is scarce and not conclusive. At present, the effects of these substances on human health and on environment are not well known. Thus, using these substances as substitutes for BFR may appear really risky.

Motivating stakeholders, and involving all concerned partners in establishing the policy can be crucial elements in the process of developing a product and indoor environment policy. Cooperation between the government and representatives of the manufacturers is quite well developed in certain countries, for example in Sweden. Informal contacts established by the Swedish government with a number of representatives of the building and property sector have conducted to a unique project trying, on a voluntary basis, to reduce environmental impact of the building sector. The program provides that the use of hazardous substances within the building sector should be reduced to a minimum by the year 2010, and that by the year 2006 the main part (more than 75 %) of the relevant building products on the Swedish market should have building product declaration. At present, the results of the program are not known yet.

Another voluntary action, well accepted by the building sector, is the labelling system. At present, there are many different labels in the world, and even several labels in a single country (e.g. Sweden). The results of this policy was e.g. in Finland, that manufacturers and importers of construction materials have improved the quality of their product so much that the measured emissions have decreased by a factor of thousand or more in some cases. This development and production of less emitting materials has also proved to be economically profitable. Although producing of better quality materials may require some extra cost, they were limited and negligible when compared with the advantages in the marketing of their products. As soon as the manufacturers have realized this, they started to take an active part in the system
Unfortunately, not all policies have such positive image, and excellent results. The total ban on trichloroethylene in Sweden was rather a failure because it did not result in a complete phase out of the substance. The use of trichloroethylene was reduced, but the same effect, if not better, could be probably achieved at lower cost using another kind of policy (e.g. taxes). The reactions of the producers were very negative, and even violent. In fact, many companies were protesting against the ban using all available means: articles, petitions, protests, finally reference to the European Court of Justice.

The German AgBB scheme was initiated in 2000. The AgBB commission is a task force of public health authorities. After having been published (AgBB 2000), the scheme was extensively discussed with, representatives of manufacturers and professionals, and certain parts of it were modified before the introductory period. After an introductory period of two years the Committee has assessed the experiences with the scheme and reported it in an appropriate way.
A similar effort of consultation happened in California, were the Report on Indoor Quality (ARB. 2005) was presented to industry and general public, who were both given opportunities to comment the entire report. Certainly in the United States, cooperation with stakeholders is important to implement new legislation.

Another strategy, a government might use to improve the quality of building products towards indoor air quality, is to create a market for those improved building products. In California, this was done in 2000 when the Department of General Services' (DGS's) Procurement Division was in the process of issuing a request for bids for a three- year, $60 million open office systems furniture contract. To address this issue, several state agencies worked with DGS, the systems furniture industry, and private consultants to issue a benchmark environmental specification for procuring open office systems furniture. This specification was issued in December 2000, and included testing and selection criteria for indoor air quality as well as requirements for recycled contents and lighting. These specifications (Section 01350) are now being implemented in other programs like the Collaborative for High-Performance Schools (CHPS). Because of the large scale of the demands, using environmentally friendly building products didn't cause an increase of costs.

Periodic controls

Periodic controls which verify introduced measures are very useful for the preparation of future regulations. Unfortunately, such controls are not always conducted, and if an evaluation was undertaken, its results remain confidential. The study published by Sterner and Slunge (2001) is a unique example of a critical evaluation of the national regulation on usage of chemical substance. The study compares the results of different policies aiming to reduce usage of chlorinated solvents. The evaluation was made by comparing the usage of the regulated substances before and after the date the regulation came into effect. Among three measures cited in the study, i.e. total ban, taxes, and technical requirement, the former one had the worst results in terms of expected effects.

The guideline values of ventilation help designers and constructors of buildings to select adequate ventilation systems in order to prevent high concentrations of harmful substances. However in practice, the ventilation systems exist only in the design stage of building preparation. As ventilation means also additional energy costs, the systems are not finally installed or simply not used by occupants of the buildings (A. Pien, CSTC - personal communication). In Sweden, a nation-wide check-up containing measurements and assessment ventilation systems, in existing buildings, has been performed. This obligatory survey of ventilation systems has revealed many situations where the functioning of these systems was not at all satisfactory (WHO, 1999).
The results of the survey conducted in Sweden prove the importance of verification of applied methods and measures. Inspection and verification systems are non-existent or ineffective in most countries. In Poland, even in the case of buildings that obviously do not meet the requirements, the inspection system is not able to prove the fault and to punish the designer or builder.

In some cases, there are no specific criteria to directly verify the effectiveness of indoor policies. The French National Environmental Health Action Plan (PNSE) established three criteria to be able to verify if the objectives of the action plan were fulfilled:

- carbon monoxide intoxications: 30% reduction within 2008
- 50% building products with consumer information on health characteristics (indoor emissions) within 2010
- 20 000 dwellings renovated every year.

In fact, every policy program should use particular criteria corresponding to expected results and implemented measures.

The labelling systems, by the principle of their functioning, warrant regular verification of the quality of labelled products. In the Finnish classification system, for example, the label is attributed for three years, after which period the producer is obliged to pass all test methods again to acquire the label for the next three years. In this case, emission tests allow to verify if the material can be classified. In the emission tests carried out by the State research centre, all measured emissions from the classified, M1 labelled, materials were essentially lower than emissions from non-classified materials. Another kind of verification was carried out to prove that good quality materials ensure good quality of the indoor air. Two blocks of flats were investigated: one built in the conventional way, and the other one by following the instructions of the classification system. Indoor air parameters were measured in the two types of buildings. Concentrations of many harmful substances were significantly lower in buildings built with M1 labelled materials than in those built with non labelled materials (Tuomainen et al. 2001).

In response to an ARB survey (California), members of the composite wood industry responding to the survey (53%) indicated that 100% of their particleboard meets the HUD large chamber test concentration of 0.3 ppm (this chamber concentration is not equivalent to the concentration that would be expected in a home). Industry data provided to ARB by the Composite Panel Association indicate that emissions of particleboard have decreased by 80% since the 1970s. Substantial lower emissions can be obtained by replacing urea-formaldehyde resin with Coated products and phenol-formaldehyde resin products.

Scientific studies

It is obvious that environment legislation must be based on exact scientific knowledge. Since the years 70s, when indoor air problems were notified, many studies have been already carried out in Europe and in the world. First investigations were conducted in Canada, and they concerned emerging problem of formaldehyde in mobile homes insulated by foams containing this substance. Nordic countries are particularly interested in moisture problems quite frequent in cold climate. Many projects studied penetration of radon inside buildings, and its influence on health. For several years now, volatile organic compounds, pesticides, and other chemical substances are in the centre of interest of many scientists.

There are many different European, international and national studies. Sweden, for example, carries out more than 30 projects during every three years periods on different topics in the indoor air domain.

An interesting study started four years ago in France. The Observatory of the Indoor Air Quality (in French: Observatoire de la Qualité de l'Air Intérieur), especially created for this purpose, conducts measurements of physical, chemical and biological indoor air pollutants in about 800 dwellings, schools and public buildings every year. The aim of the study is to better understand the determinants of indoor air quality and strengthen regulations. The

results of analyses were used to establish a list of 70 prioritising pollutants including chemical and biological agents (Appendix 3, Summary for France).

In 1992, the German Federal Government published it's first *"Konzeption zu Vebesserung der Luftqualität in Innenräumen" (Concept to Improve Indoor Air Quality).* This concept contained 13 main points that should be focused on and already detailed previously in this text.
In 2004, a follow up report was compiled *"Verbesserung der Luftqualität in Innenräumen – Ausgewählte Handlungsschwerpunkte aus Sicht BMU" (Improvement of Indoor Air Quality – Selected Main Points of Action from the Angle of BMU)* pointing out that future actions should be taken care of:

- Improvement of the self responsibility of the consumers and occupiers of the indoor rooms;
- Tightening up of the chemical regulations (REACH);
- Act for the Protection against Radon;
- Investigation of the characteristics of the end-users;
- Health-based requirements for building products;
- Further developments for Indoor Air Guidelines and HBM (Human Biomonitoring) guidelines;
- Analytical Quality Assurance;
- Encouragement of cooperation between industry, science and environmental federations;
- Research;
- Strengthening of Indoor Air Hygiene as autonomous political domain.

More information on indoor research projects is collected in databases. There is, as an example, an interesting database developed by the University of Leicester in the UK. It is publicly available through: IERIE (Inventory of European Research on the Indoor Environment) on website http://wads.le.ac.uk/ieh/index.htm

Indoor air services

Indoor air services exist in several countries, but their role and principle of work differ from those of SAMI in Belgium.
Germany has a well developed system of such services which role is to detect pollutants in houses of persons who have health problems. The services are mainly private companies, but they collaborate with doctors and with social security agents. The costs of the visit are partially redeemed by the social security if the visit was required by a doctor who participated in a special formation on environment. In this way, the main aim of the services is to help the doctor to make the diagnosis. They detect indoor pollutants, and give recommendations how to improve the quality of indoor environment.
The services in Nordic countries are also private companies, but all the costs linked to detection of pollutants must be paid by persons. Some institutions and universities have teams working in indoor air domain, and they agree sometimes to analyse the indoor air in case of health problems. This is usually possible in the frame of specific studies on the subject if the problem corresponds to the criteria of the study.
French Observatory of the Indoor Air Quality has created a service that measures indoor parameters and pollutants. The aim of the service is to prepare a database of the most important pollutants in French dwellings. At present, the service is purely scientific, and is not used as means to improve the human health.

Few years ago, the University of Strasbourg created a formation for future environmental advisers. The formation is addressed mainly to nurses and other paramedical professions. These environmental advisers visit dwelling of allergic persons, and give them advices on how to avoid exposition to allergens and toxic pollutants. Besides house dust mites, environmental advisers do not detect other pollutants.

The budget spent on indoor air and products quality is a somewhat controversial topic of general interest. Among studied countries, only the USA is rather open in publishing this information. As an example, the Californian Environmental Protections Agency's Department of Toxic Substance Control receives 132 million dollar of state funds and the ARB (Air Resources Board) 247 million dollars which is respectively 0.1% and 0.2% of the total state budget. The ARB also regulates consumer products, for the purpose of reducing smog in California. An additional benefit is a reduction in the amount of certain types of VOCs that are released in homes and institutions.

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4 Conclusion

Indoor air has become recently an important subject in the scientific world. A number of research studies have proved a great influence of indoor environments on human health. However, there are still many elements missing to be able to manage the risks and to establish adequate legislation.

Two basic technical solutions are available for indoor risk management strategies: source control, and dilution of pollution. The latter has been present in national legislations for many years. These are ventilation standards and guidelines fixed for different kinds of confined spaces. They are prepared in a way to ensure good air quality for the general population. Source control is not well developed, and not present at all in some countries (France).

The technical solutions mentioned above, are in Belgium under jurisdiction of different governments. Product Policy is under Federal authorisation, and the indoor air quality is a competence of the Regions.

Regulations aiming to limit usage of certain toxic substances, and concerning products used indoors are rather scarce. European countries apply European directives and recommendations, and make very rarely their own initiatives. For this reason, the substances regulated already in the Directive of dangerous substances are also regulated on the national levels. Up to date, the usage of only few substances is regulated: formaldehyde, benzene, some glycol ethers, brominated flame retardants, chlorinated solvents, vinyl chloride.

The only substance, being the subject of the study, regulated in every country on a national level is formaldehyde. Regulations of this substance are product-oriented – the content or emission of formaldehyde is limited in building materials. Germany and Poland limit also use of several other substances in building products. It is a very useful means to control sources of pollutants, but it is not well developed yet or in development stage. The reason of the situation is the lack of information on toxicity of many substances, and their behaviour in indoor environments.

Regulations of some substances are applied to other type of products, e.g. content of benzene is limited in toys; aerosols should not contain vinyl chloride; some brominated flame retardants may not be used in textiles intended to come into contact with skin; children’s toys may not contain phthalates.

Governments of several countries published official lists of priority, undesirable substances. In establishing these lists, the most often used properties of substances are linked to their effects on the environment and human health. There are also lists of undesirable substances initiated by industries, as it is the case of the BASTA system in Sweden. The substance properties are based on the plans in the forthcoming REACH regulation. Adopting the same criteria as in REACH should help industry to be better prepared for the new European regulation, and to have enough time for all necessary modifications of production procedures. The priority lists inform about a potential danger from using certain substances, for which there is no national or international regulation. In this sense, they do not regulate the substances but warn about a possible regulation in the future.

Strict and radical regulations are not well appreciated by industry. The total ban on trichloroethylene in Sweden was rather a failure because it did not result in a complete phase out of the substance. The use of trichloroethylene was reduced, but the same effect, if not better, could be probably achieved at lower cost using another kind of policy (e.g. taxes). The reactions of the producers were very negative, and even violent. In fact, many companies were protesting against the ban using all available means: articles, petitions, protests, finally reference to the European Court of Justice.

Labelling systems seem to be effective and well appreciated by both producers and population. The known labelling systems show a very good development. The number of products acquiring labels is growing every year, the quantity of products purchased grows as well. The labelled products are regularly verified, what warrants their good quality. Some studies prove lower concentrations of volatile organic compounds in a building built with labelled materials compared with the building built in a traditional way.

In order to improve the health and environmental characteristics of building materials, the French government has decided to set up a labelling system. The system shall be promoted by the government by, for example, using labelled products in State building, and inviting the local communities to do the same, especially for schools. Consolidating a database on construction products shall help building companies and private persons choosing environmentally better products.

The ventilation standards are closely linked to another measure - guidelines for the quality of indoor air. The guidelines are generally limited to a few substances, most often carbon monoxide, carbon dioxide, formaldehyde, radon and asbestos. The guidelines by their purely informative character cannot improve the quality of the air in private dwellings, but they may help to prepare specific regulation.

5 Recommendations

Preparation and implementation of environmental legislation is a difficult and sometimes delicate matter. It has to take into account many different aspects such as human health, protection of environment, economical development, quality of life, and population acceptance. This responsible task should be made in collaboration with specialists in different domains. Only general recommendations and remarks pertinent in implementing a product policy are mentioned.

- Action to better inform consumers on the environmental characteristics of products and to encourage producers to develop a better design of products is needed. General information about indoor air quality and risks should be available to everybody. It arises the population awareness, and incites to purchase better quality, low emitting materials. The public and manufacturers' awareness is a key point in any regulation concerning products used indoors.

- Legislation must be science based. Research projects on different aspects of indoor quality and on the influence of chemical substances on human health and environment are necessary. Interactions between science and policy are inherent in regulatory decision making. Each policy must be based on solid, scientific knowledge. Different aspects linked to the usage of chemical substances should be taken into consideration, including latest research and development, technical support, analytic methodology, data collection, interpretation and assessment of health and environmental risks. If the information is not concluding, the precaution principle should be applied.

- As far as firms are concerned, one can expect them to improve their environmental performance, including the environmental quality of their products, when it is in their commercial interest. Companies retain a competitive advantage by offering a better product, offering a less expensive product, or offering a better but only slightly more expensive product. Product innovation is, therefore, a key aspect of being competitive for the chemicals industry.

- Voluntary agreements play an important role, especially if they can contribute to reducing exposure more rapidly or effectively than legally enforceable national or international regulations. Labelling systems are not perceived as limiting the market. Very often, they incite producers to improve their products, and to develop better technologies. They are easier to modify, which ensures rapid application of the latest knowledge.

- Given the importance of the public sector, its purchasing activity is one of the most influential factors, allowing for the development of a significant "green market". In order to "green" the demand side in general, information plays a crucial role.
- Communicating with stakeholders may not be neglected. Instructions must be direct and understandable; measures shouldn't be too heavy administratively.
- Motivating stakeholders, and involving all concerned partners in establishing the policy can be crucial elements in the process. Cooperation between the government and representatives of the manufacturers warrantees the success of the measure.

- When preparing legislation regulating usage of chemical substances (in indoor products), special attention should be paid on possibilities to replace them by others, less dangerous compounds. A good knowledge on the proprieties of the substances, possibility to use them in particular products, their compatibility with other components of finished products, the technology of production, etc. is essential in taking the decision on substitution.
- Listing hazardous substances can serve as a base for product planning, and a guide to what should be avoided by product manufacturers. It is important that the list should be comprehensive, and include substances of different hazardous properties.

Appendices

Appendix 1: Questionnaire and Summary of Questionnaires
Appendix 2: Workshop
Programme and Proceedings (Copy of Slides)
Minutes of Round Table and Interviews

Appendix 3: Summary of Product and Indoor Environment Policy per Country
Priority countries: Sweden, Finland, France, Germany, California
Other countries: Canada, Denmark, Poland

Appendix 4: CD-ROM with Database
Appendix 5: Presentation of Final Report

Appendix 1: Questionnaire and Summary of Questionnaires

Questionnaire

Questionnaire Introduction letter

Dear Colleague,

The Belgian Federal Government, in cooperation with the Regions (Brussels, Flemish and Walloon), has launched a study entitled: " Product Policy in the context of the Indoor Environment". The study is executed by VITO (Flemish Institute for Technological Research) and ULg (Université de Liége – Département des Sciences et Gestion de l'Environnement).

The aim is to collect and summarize information on the indoor product policy currently applied in a selection of countries. The objectives are to obtain information on the:

- product policy measures in 5 countries for 14 indoor contaminants;
- product policy measures in these countries for other chemical indoor contaminants;
- overall indoor environment policy.

As a first step, the enclosed questionnaire (part one and two) is sent out to contact persons in the selected countries. The first part of the questionnaire contains only tick boxes and is used to detect the contacts able to provide more detailed information on these topics; the actual information is only requested in the second part of the questionnaire. Part 2 is now only present for your information. It will be returned later to those contacts able to provide the required detailed public available information (web sites, reports, publications, databases, legislation sites, …).
The purpose of this "two phase approach" is to avoid duplication of work. You will receive again, for completion, the second part of the questionnaire with behind each topic the contact person able to provide the information.

You will notice in part 1 of the questionnaire that a workshop on this topic is scheduled later this year. One key reference from each country will be invited to present in about 30 minutes the essential principles and results of their current product policy (for the indoor environment). Travel and hotel cost will be reimbursed.

All information eventually available, through this questionnaire, internet search, workshop, etc, is summarized in a database which will, already in its initial state, be open for everyone providing information. The language of the database is English.

The contact persons receiving the questionnaire in your country are: ….. e-mails only.

Looking forward to a fruitful cooperation, we remain,

Yours sincerely,

4 names (2 VITO /2 ULg)

Enclosed: questionnaire part 1: to be returned by e-mail: by preference before 10 Mai
questionnaire part 2: sent by 15 Mai; to be returned by 30 Mai

Product Policy in the context of the Indoor Environment

Questionnaire PART 1 (to be completed)
Country: …. (e.g. UK)

Please tick the appropriate box after the questions. This part of the questionnaire includes already the actual questions but requests no detailed information yet.
The topics (questions) are put in the order of importance. Don't hesitate to contact us in case you need clarifications:

- e-mail for UK, Germany, USA: maarten.spruyt@vito.be or eddy.goelen@vito.be
- e-mail for other countries: mkuske@ulg.ac.be or J.Nicolas@ulg.ac.be

Thanks in advance for your time.

1. Which product policy measures* are implemented in your country in order to reduce/prevent indoor pollution due to the 14 pollutants listed in the table below?
* meant are measures to reduce direct indoor sources; measures for indirect sources (infiltration, outdoor environment, personal behaviour) are excluded

Product policy measures requested (later, in part 2) for each pollutant are:

- list of measures taken (1.1)
- list of measures in preparation (1.2)
- list of results obtained (e.g. observed decreased concentration levels, evaluation reports on results of policy measures, observed effects of substitution products, evaluation reports on the implementation and/or enforcement) (1.3)

Can you provide the information requested in question 1? Y/N (tick box below)
If no, who is the contact person?
Tick the column with heading "O" in case there are for these pollutants no product policy measures in your country.
Tick the column with heading "D" in case there is a national (not e.g. WHO, ..) public available scientific file/database (e.g. about exposure, toxicity, dose - response relations, ..)for the pollutant.
Please add in line 15 other pollutants for which measures are/will be taken.

	Indoor contaminant	Y	N	Contact person (e-mail, phone)	O	D
1	formaldehyde					
2	1,2,4-trimethylbenzene					
3	α-pinene					
4	toluene					
5	triclosan					
6	methylene-di-isocyanate					
7	glycol ethers					
8	permethrin					
9	D-limonene					
10	benzene					
11	acetaldehyde					
12	vinyl chloride					
13	trichloroethylene					
14	brominated flame retardants					
15	List of other pollutants for which product policy measures are/will be taken:					

2. Indoor Environment Policy

Information (e.g. list of documents) regarding questions 2.1 to 2.8 is requested (later) in part 2.
At this moment, only complete the tick box below.

2.1. Which policy instruments are used and which authority is (authorities are) responsible for implementation/enforcement?
2.2. What is in your country the importance of product policy measures as compared to other indoor policy instruments (e.g. in terms of man power, financial means, realizations)?
2.3. Which contaminants have priority for the indoor environment policy. Please mention the contaminants tackled by source approach (e.g. product policy) and those subject to exposure reduction measures (e.g. measures in the context of personal behaviour, ventilation, building characteristics/design,…). Is there a (public available) scientific back up document to support this priority list of contaminants?
2.4. Which are the guideline or limit values for indoor contaminants in your country?
2.5. Which are the indoor policy measures focused on specific target groups (e.g. young children, elderly, disabled,..)?
2.6. Where can we find the (public available) results of indoor research programmes/projects (e.g. database, websites,..) executed in your country?
2.7. What budget is spent to the indoor environment policy (e.g. estimation in terms of man power, estimated annual budget for research, estimated annual budget for the indoor policy) in your country?
2.8. Which are the evaluation criteria to verify the effectiveness of the indoor policy?

Can you provide the information requested in questions 2.1-2.8? Y/N (tick box below)
If no, who is the contact person?

Question nr	Y	N	Contact person (e-mail, phone)
2.1			
2.2			
2.3			
2.4			
2.5			
2.6			
2.7			
2.8.			

3. Which delegate(s) from your country would be the most appropriate person(s) to present an overview of the topic "product policy in the context of the indoor environment" in a dedicated 1 day Belgian workshop to be held in Brussels this year (preliminary dates are September 19, September 23, October 3, October 17)? Delegates from five countries will be invited (expenses are reimbursed/ language English; another language for presentation is possible on special request)

The preliminary programme is: ½ day presentations, ¼ day panel discussion, ¼ day questions/interview, social evening event.

Please complete the box below

	Name/Institute/Address	E-mail	Phone
Contact			
Alternative contact			

This is the end of the questionnaire part 1. Thanks for your help and taking the time to complete it.
E-mail the completed questionnaire back to the sender. You will receive part 2 by 15 May.

Product Policy in the context of the Indoor Environment

Questionnaire PART 2 (at this stage for information, will be returned for completion by 15 May)

Country: …. (e.g. UK)

Your answers maybe in a summarizing style. It is hoped that you can **provide a list of documents (websites, reports, publications, databases, legislation sites,…)** where further detailed information can be found. Complete only the information where you are listed as contact person (see tables); languages: English, French, German.

Don't hesitate to contact us in case you need clarifications:

- e-mail for UK, Germany, USA: maarten.spruyt@vito.be or eddy.goelen@vito.be
- e-mail for other countries: mkuske@ulg.ac.be or J.Nicolas@ulg.ac.be

Thanks in advance for your time.

1. Which product policy measures* are implemented in your country in order to reduce/prevent indoor pollution due to the 14 pollutants listed in the table below?
* meant are measures to reduce direct indoor sources; measures for indirect sources (infiltration, outdoor environment, personal behavior) are excluded

Product policy measures envisaged for each pollutant are:

- list of measures taken (1.1)
- list of measures in preparation (1.2)
- list of results obtained (e.g. observed decreased concentration levels, evaluation reports on results of policy measures, observed effects of substitution products, evaluation reports on the implementation and/or enforcement) (1.3)

Please complete the table with answers and/or a list of documents for items 1.1,1.2 and 1.3.

1	Formaldehyde	Contact person(s): …….
Documents (mention for which item: 1.1,1.2 or 1.3)		

2	1,2,4-trimethylbenzene	Contact person(s): …….
Documents (mention for which item: 1.1,1.2 or 1.3)		

3	α-pinene	Contact person(s): …….
Documents (mention for which item: 1.1,1.2 or 1.3)		

4	Toluene	Contact person(s): …….

Documents (mention for which item: 1.1,1.2 or 1.3)

5	Triclosan	Contact person(s): …….
Documents (mention for which item: 1.1,1.2 or 1.3)		

6	methylene-di-isocyanate	Contact person(s): …….
Documents (mention for which item: 1.1,1.2 or 1.3)		

7	glycol ethers	Contact person(s): …….
Documents (mention for which item: 1.1,1.2 or 1.3)		

8	Permethrin	Contact person(s): …….
Documents (mention for which item: 1.1,1.2 or 1.3)		

9	D-limonene	Contact person(s): …….
Documents (mention for which item: 1.1,1.2 or 1.3)		

10	Benzene	Contact person(s): …….
Documents (mention for which item: 1.1,1.2 or 1.3)		

11	Acetaldehyde	Contact person(s): …….
Documents (mention for which item: 1.1,1.2 or 1.3)		

12	vinyl chloride	Contact person(s): …….
Documents (mention for which item: 1.1,1.2 or 1.3)		

13	trichloroethylene	Contact person(s): …….
Documents (mention for which item: 1.1,1.2 or 1.3)		

14	brominated flame retardants	Contact person(s): …….
Documents (mention for which item: 1.1,1.2 or 1.3)		

15	pollutant x……..	Contact person(s): …….
Documents (mention for which item: 1.1,1.2 or 1.3)		

2. Indoor Environment Policy

2.1 Which policy instruments are used and which authority is (authorities are) responsible for implementation/enforcement?

2.2 What is in your country the importance of product policy measures as compared to other indoor policy instruments (e.g. in terms of man power, financial means, realizations)?

2.3 Which contaminants have priority for the indoor environment policy. Please mention the contaminants tackled by source approach (e.g. product policy) and those subject to exposure reduction measures (e.g. measures in the context of personal behavior, ventilation, building characteristics/design,…) . Is there a (public available) scientific back up document to support this priority list of contaminants?

2.4 Which are the guideline or limit values for indoor contaminants in your country?

2.5 Which are the indoor policy measures focused on specific target groups (e.g. young children, elderly, disabled,..)?

2.6 Where can we find the (public available) results of indoor research programmes/projects (e.g. database, websites,..) executed in your country?

2.7 What budget is spent to the indoor environment policy (e.g. estimation in terms of man power, estimated annual budget for research, estimated annual budget for the indoor policy) in your country?

2.8 Which are the evaluation criteria to verify the effectiveness of the indoor policy?

Please complete the table with a list of documents or answer in summarizing style.

Question nr 2.1	Contact person: …….
Documents or answer	

Question nr 2.2	Contact person: …….
Documents or answer	

Question nr 2.3	Contact person: …….
Documents or answer	

Question nr 2.4	Contact person: …….
Documents or answer	

Question nr 2.5	Contact person: …….
Documents or answer	

Question nr 2.6	Contact person: …….
Documents or answer	

Question nr 2.7	Contact person: …….
Documents or answer	

Question nr 2.8	Contact person: …….
Documents or answer	

This is the end of the questionnaire. Thanks for your help and taking the time to complete it. E-mail the completed questionnaire back to the sender. You will receive later the (web)link to the database.

Appendix 2: Workshop

Proceedings of the workshop
To be downloaded from VITO ftp server; see enclosed link mentioned in email (digital version) or on enclosed cd-rom (hard copy version)

Minutes of the round table and summary of the interviews

Minutes Round Table Discussion

Present
Maarten Spruyt, Eddy Goelen, Jacques Nicolas, Martyna Kuske, Pierre Biot, Marie Becker, Jorma Sateri, Nathalie Tchilian, Hal Levin, Maja Mampaey, Ernundo Gil, Francoise Jadoul, Sandrine Bladt, Ralph Baden, Catherine Bouland.

Question: Should *Product Policy be product orientated or contaminant orientated?*

Answer 1 (USA): Both are important. You can't do only one of them and the topic is to broad. The initiation of either one of them is influenced by the stakeholders.

Answer 2 (Sweden): In Sweden, ngo's pressed the industries to do the work; therefore there are a lot of voluntary labels over a wide range of all day products (not only building products). The products are on the market, and the people are interested to know what is in the products. So you also need to give information on the contaminants used in the products. Conclusion: You need them both.

Answer 3 (Luxemburg): In Luxemburg, the "green ambulance" drives out to people with symptoms and then makes analyses of the houses *open minded*. The project deals with a couple of thousand houses per year. One of the actions is looking for a correlation between the symptoms and substances found. If something is found, the next step is to get rid of it. One of the advantages of this project is that it is very dynamic. Concerning health effects, a contaminant starting point is very interesting.

Question: Is *There an Independent Framework to Guarantee Quality of the Voluntary Labels?*

Answer 1 (Sweden): Labels should be based on different stakeholders, and voluntary.

Answer 2 (Finland): In Denmark and Finland basis and criteria for labelling originates from the academic world. Even industry-based labelling systems are not necessarily bad. The industry wouldn't want to risk their own reputation with a faulty label. To initiate a labelling system: one should start with the biggest hazards, rather than an a priori approach through contaminants or products, perhaps it might be socially like ventilation. Also building products are very important.

Answer 3 (USA): If you only look to the indoor environment, you are part of a very small community (for Public/Scientific Awareness). First use Time Activity Patterns (TAP) to prove the importance of indoor air on total exposure. Then you can convince also other sciences/scientists like e.g.toxicologists.

Question: *Is a Global Approach for Product Policy Possible in Europe? What Legislation/Regulation? Who's Responsible*

Answer 1 (USA): No, it isn't. Each area has it's own specific problems. Therefore one should first discover the biggest hazards and the pollutants you're exposed to. Hal Levin has once done a study were he surveyed top literature, where he looked to the highest concentrations measured of certain pollutants and compared it to the lowest advised guidelines. When those two meet each other, there might be a real danger towards exposure. Health effects, for instance carcinogenicity, are also very important.

Answer 2 (Finland): Governments are always a step behind. As soon as a pollutant draws attention, it gets replaced by another unknown. It was suggested that manufacturers are nowadays replacing a lot of VOC's by SVOC's. It should be noted that a lot of manufacturers don't really know what contaminants are present in the base products they use for their production. One of the big benefits of emission testing is making the industry itself aware of what comes out their products. Product Analyses may also contribute. Another procedure to obtain the same result is grinding and analyzing the product.

Question: *What about the quantities mentioned on the labels?*

Answer 1 (Sweden): If there is a guideline value available for the indoor concentration, you can calculate back with average surfaces to Specific Emission Rates.

Answer 2 (USA): Another approach is applying worst case scenario's, e.g. for schools. With low ventilation and maximal surfaces in average rooms, you can establish a label with SER's. Afterwards you can use the real values for a specific school to compare with guidelines.

Question: *What is the effect of introducing a label?*

Answer 1 (USA/Finland): Labels and emission testing are a way to get rid of the worst companies.

Answer 2 (Finland): A label has no effect on the price. In the industry, labels are considered as marketing, and paid from the marketing budget.

Question: *How can one initiate a labelling system?*

Answer 1 (Finland): In Finland, FISIAQ initiated labelling schemes in 1995 with a publication. It was about a study where respiratory patients were put in low emitting materials, and a substantial improvement of there living quality was the conclusion. The labelling scheme started in 1996 and after the companies picked it up, it has been steadily growing ever since.

You should also use global labels, for instance the same labelling scheme for all building products.

Answer 2 (USA): A fast start can be obtained by requesting low emission materials to be used in all new governmental buildings.

Question: *How about legislation/guidelines. Can one import outdoor limits to indoor environment and transfer ambient source tackling strategies to the indoor environment?*

Answer 1 (Finland): Yes it is. As a matter of fact, you first need indoor air quality guidelines before you can initiate product's emission level policies like labels. An economic difference between regulation and voluntary labels is that regulation requirements are accounted on the industries R&D budget and voluntary measures are accounted on the marketing budget.

Answer 2 (ALL): A possible start is publishing what you already know, and make it public. Then the pressure comes from the public and not from the government. It is also possible to publish links towards respectable instances that have information, such as WHO, foreign governments.

Answer 3 (USA): It is a good strategy to start with 'higher' limit values which the industry can meet without much expenses. Then you can bring the values to lower levels with enough time for the industry to adapt. If you start with low level guidelines, no one will want them.

Answer 4 (Finland): You need protocols and methods to check existing buildings. Guidelines are more difficult. Measurements are also more expensive then a checklist with certain predictable indoor air problems. If you foresee a flowchart with known problems, you can minimize the measurements needed, and one obtains a much more efficient policy.

Conclusions From the Interviews

Sweden has implemented European directives concerning dangerous substances. In general, there are regulations concerning chemical substances but only few specific product regulations (source approach) – an exception is the formaldehyde regulation for some wood products for indoor use. Sweden uses different forms of environmental policies to regulate usage of different substances. Mostly, there are general guidelines or recommendations how to judge different indications/circumstances that can be risk factors for human health.
There are voluntary initiatives and programs from the building sector whose aim is to reduce the environmental impact of the building sector. In the BASTA system, one of such initiatives, the Swedish construction sector has agreed on a common definition of the substance properties for the decision as to whether a product is to be accepted or not. The substance properties are based on the plans in the forthcoming REACH regulation.

In **Finland**, the labelling system is independent from the industry and from the government. The government supported creating the labelling system, but didn't make publicity of it. In fact, the public was already aware of problems linked to indoor pollution.
The labelling system in Finland is efficient because it is regarded as incitation of development, and a good indoor policy should promote development. Setting of targets is also important: it is better to establish good and very good quality criteria, not only minimum emission admissible. The idea to have three different levels of labels is not contradictory for producers, and at the same time incites producers to improve their products.

At present, office buildings in Finland are built in good quality materials even if there is neither obligation nor recommendation to choose labelled materials for these buildings.

In the **United States of America**, the Environmental protection office (US-EPA) has the right to ask the manufacturers the composition of their products whenever there's a suspicion of harmfulness under the Toxic Substances Control Act (TSCA). The US-EPA's Office of Research and Development (ORD) also develops methods for testing emission of building materials, which has resulted in the ASTM emission test guidance document (D5116-90). The other early federal instance of emissions testing is the Consumer Product Safety Commission which was concerned about formaldehyde emissions and emissions of VOC's from carpets. Contrary to the EPA, they have the authority to regulate products. The Department of Housing and Urban Development required labelling of formaldehyde emissions from composite wood products in the mid-1980s for products used in mobile homes and manufactured housing.
A lot of work is also done by the different states, where the State of California leads the way. The Californian viewpoint is health and they are active in different fields, as for example Proposition 65, the California Integrated Waste Management Board (CIWMB) and Californian Indoor Air Quality (IAQ) Program. Section 01350, Special Environmental Requirements Specification, is another example. Section 01350 contains specification language on environmental and public health considerations for building projects. This specification establishes goals and provides an overview of special environmental requirements. It covers guidelines for energy, materials, and water efficiency, indoor air quality (IAQ), non-toxic performance standards for cleaning and maintenance products, and sustainable site planning and landscaping considerations, among other measures. The Californian Indoor Air Quality (IAQ) Program also operates a portal website which gathers information of several factors influencing the air quality: http://www.cal-iaq.org/.

Round table preparatory document

Workshop "Product Policy in the context of the Indoor Environment"
Brussels, 7 October 2005

Preparation of the Round Table Session (13.30 h– 15.00 h)

"Setup and Approach for a Product Policy related to IAQ in Belgium"

Topics to be discussed at the round table

1. **Suggestions for a product policy in Belgium: future perspective and possibilities based on ongoing activities in the participating countries**

a. Product orientated – Contaminant orientated
b. Compulsary – Voluntary
c. Source approach – Global indoor environment regulation (guideline/intervention values)

Items of discussion for 1a – b - c
e.g. German: DIBt, AgBB approach (CESAT Fr), including LCI concept; Californian: CHPS approach, Finnish classification scheme, others of interest (Ind Climate Label, Nordic Swan)
e.g. Relevance of product composition as first step: international priority contaminants VS Eupen list; current restrictions VS in preparation; equivalence principle.
e.g. Emission Testing and link to indoor guideline values; other protocols (e.g. FLEC) and standardization for implementation of product testing schemes
e.g. legal background: CPD EU Directive and other legal frameworks; how about other indoor products (furnishings, consumer products,…)
e.g. Voluntary schemes: Blue Angel, Umweltzeichen, ICL, GuT (carpets), CertiPUR (foams), EMICODE (adhesives), Natureplus (Eur), CRI(USA), Greengard (USA),etc.
e.g. odour /olfactory aspects

d. Responsible for implementation and enforcement

e.g. role of manufacturers - distributers, government, scientific institutes, universities, ngo's.
e.g. governmental administrations or others (e.g.private agency's)
e.g. who is going to do/pay the field work (e.g. in case of testing or IAQ LV's)

e. Priority products or contaminants

e.g. Health based lists, divided into health effects or chemical name or both. What with dust in case emissions schemes are the basic approach? Contaminant list:
e.g. LCI list, list of carcinogens (hvbg.de), 121 target emission compounds California (Alevantis 2003), EPA ChronicReferenceExposureLevels list, EPA toxic air cont list, other lists (e.g. WHO)
e.g. carcinogens, mutagens, reprotoxins, PBT (persistent, bioaccumulative, toxic), vPvB, substances that cause irreversible effects to humans or environments
e.g. CEN: aldeh, phthalates, phenols, hydrocarbons, halog organosphosp comp, dangerous particles, gases, VOC's

e.g. Classification of product types

f. Product Labelling: way forward?
g. Public awareness – involvement of public
h. Budget: who contributes
i. Effect on product sales: advantage / disadvantages of fulfilling requirements

2. Alternatives to product policy

a. IAQ limit and guideline values, vehicle interior air limit values (e.g. Ford), OE LV (divide by factor 10-100), others applicable (e.g. environmental)
b. Actions toward substitution products
c. List of alternative policies under investigation – Experiences with failing policies (available back up documents)
d. Responsible authorities in the different countries (for other than product policies)
e. Importance of product policies compared to other IAQ policy instruments
f. Exposure reduction measures: ventilation, personal behaviour, building concepts, sustainable products/materials, ..
g. Special policies focused on target groups: young children, elderly, disabled,..

3. Other subjects related to improving the indoor environment quality

a. related ongoing activities in countries, Europe, worldwide

topics: e. g. expert group on dangerous substances (CPD), EU database Eur and national regulations for dangerous substances in GPSD (CPD): http:// www.jrc.cec.eu.int/eis-chemrisks, mandate for CEN, ASTM and ISO, ECA, other activities

b. related research databases and projects/programmes
c. output of research projects used in policy preparatory work/projects
d. Effectiveness of applied policy: how is this verified?
e. Link to REACH?

Remark

The time at the workshop for the round table session seemed to short for a discussion of all these items. All these topics would require a whole day of discussion and exchange of ideas. Worth doing later.

Appendix 3: Summary of Product and Indoor Environment Policy per Country

PRIORITY COUNTRIES

Sweden

The indoor environment legislation in Sweden is based on three acts:

- Planning and Building Act with it's Building regulations - regulations for new buildings and implementations of, for example, EG concerning CE labelling of building products. The National Board of Housing, Building and Planning is responsible for implementation of the Planning and Building Act. Direct/operative supervision is performed both by regional authorities, the Administrative Boards and local authorities at the municipalities. The responsible Ministry is the Ministry of Sustainable Development. The Board's website: www.boverket.se

- Environmental Code (EC) is a framework law, which means that its rules do not generally specify limit values for various operations and it does not go into detail. The rules are often made more specific by regulations issued by central government agencies.
  In the EC, the purpose of health protection measures is to prevent or eliminate impact of human health. "Detriment to human health or the environment" is defined as any disturbance that is liable to have adverse effects on health in medical or hygienic terms. Detrimental effects include heat, cold, draughts, humidity, noise, air pollutants, radon, fungal damage and similar effects and are linked to the physical environment. Residential buildings must provide adequate protection against heat, cold, draughts, humidity and noise. They must have satisfactory ventilation and let in sufficient daylight. They must provide access to water and facilities for maintaining an adequate standard of personal hygiene. Housing and premises must be kept free from infestations and other pests. English summary on www.sweden.gov.se

- Work Environment Act, for indoor environmental issues in work places is responsible for implementation and supervision is the Swedish Work Environment Authority, with ten districts of the Labour Inspectorate. The Responsible Ministry is the Ministry of Industry, Employment and Communications. The Authority's website is: www.av.se.

National agencies with interest for indoor environment issues are:
The National Board of Health and Welfare (NBHW) is responsible for regulation, among others, concerning indoor environment in houses and public premises. There are no complete guidelines for indoor air quality. There are only general guidelines and recommendations for ventilation, radon, temperature, moister and mould, health risk associated with flooring materials and cleaning in schools and day nurseries. The Board's website: www.socialstyrelsen.se
National Chemicals Inspectorate (KEMI) is responsible for risk assessment of chemical substances and products (for example, chemicals in building products, paints etc) regulated in the environmental code. It promotes legislation and supervision, approves pesticides, and

collects information about products. It is also responsible for supervision of producers and importers chemical substances. KEMI website: www.kemi.se

National Board of Housing, Building and Planning is the central agency of the Swedish government for planning, urban development, building and housing. In the field of building, the Board adopts rules and general recommendations that promote the construction of good, inexpensive housing; coordinates Swedish building regulations with the relevant EC directives; promotes healthy and environmentally sound construction.

The Swedish Consumer Agency (KO) is a supervisory authority under the Ministry of Sustainable Development who promotes legislation and rules that contribute to achieving the environmental quality objective of ´A non-toxic environment´. It maintains a number of databases, assesses the risk of chemicals, and checks companies' compliance with applicable regulations.

The KO is empowered to take legal action against companies who violate market laws. Mandatory legal rules and direct interventions form an important basis to support the consumer. Much of the work of implementing consumer policy is founded on results achieved through agreements, recommendations, etc. with the business community. An important task for the Consumer Agency and the KO is to ensure that the market complies with the laws applicable in the consumer field.

According to Product Safety Act, hazardous goods and services may be prohibited. The seller must supply the information needed to prevent injury. The Consumer Agency also enforces related EU-legislation on food imitations, safe toys and personal protective equipment. The Consumer Agency is entitled to issue **regulations** in certain cases, for instance about product safety and energy efficiency. Several regulations have also been issued on criteria for European environmental labelling.

The Agency also makes voluntary agreements with business organizations in various fields, for instance on standard contract terms in most fields and on marketing rules in specific product areas.

Government-run activities supporting consumers are well established in Sweden. Much of the work is focused on prevention through negotiations and recommendations. However, this approach is based on the ability to use legal intervention.

The Product Safety Act is intended to protect consumers from potentially dangerous goods and services. Dangerous products may be prohibited. The seller must supply the information needed for the prevention of injury.

Legislatorial regulations on dangerous substances

Sweden uses different forms of environmental policies to regulate usage of different substances. Mostly, there are general guidelines or recommendations how to judge different indications or circumstances that can be risk factors for human health. Only few contaminants and parameters have limit values, e.g. ventilation, radon, temperature, moister and mould, health risk associated with flooring materials and cleaning in schools and day nurseries (Boverket 2002 and 2005).

Sweden has implemented European directives concerning dangerous substances. In general, there are regulations concerning chemical substances but only few specific product regulations (source approach) – an exception is the formaldehyde regulation for some wood products for indoor use. Sweden has also introduced some regulations not linked to European recommendations.

In spring 1999, the Swedish Government adopted fifteen **national environmental quality objectives** (Miljomal, 2004). These objectives describe the quality that the environment and common natural and cultural resources must have to be ecologically sustainable in long term. Two of the objectives concern indoor environment: Good Built Environment and A Non-Toxic Environment. Information on www.miljomal.nu

Non Toxic Environment Interim Target 3 postulates that newly manufactured finished products will be, as far as possible, free from:

- carcinogenic, mutagenic and reprotoxic substances, by 2007, if the products are intended to be used in such a way that they will enter natural cycles;
- new organic substances that are persistent and bioaccumulating, as soon as possible, but no later than 2005;
- other organic substances that are very persistent and very bioaccumulative, by 2010;
- other organic substances that are persistent and bioaccumulative, by 2015;

mercury by 2003, and cadmium and lead by 2010.

Nor will these substances be used in production processes unless the company can prove that human health and the environment will not be harmed. Already available finished products containing substances with the properties listed above, or mercury, cadmium or lead, will be handled in such a way that the substances in question are not released to the environment. This interim target applies to substances that are man-made or extracted from the natural environment. It also applies to substances giving rise to substances with the above properties, including those formed unintentionally.

The Government has defined eleven target areas for all work in the field of public health, and one of them is - Healthy, safe environments and products – where indoor environment issues are addressed. More information on, www.fhi.se

In Swedish national objectives, both the environmental and the public health give more attention to “sensitive persons”. For example subtargets to Good Built Environment, concerning indoor environment (ventilation and radon) specially addressed measures for children’s indoor environment in schools and nurseries.

There are several **databases of chemical substances** handled by National Chemicals Inspectorate (KEMI). The aim of the databases is to reduce risks linked to the usage of chemical substances. Three of these lists are particularly important: Restricted Substances Database, PRIO database and Classification List.

The Restricted Substances Database contains substances that are restricted under Swedish legislation. A small number of substances are completely banned. Many substances are

merely regulated in a particular application. The restricted substances database is a tool for finding out about legislation relating to individual substances.
The PRIO database contains both substances that are regulated and those that are not covered by any legislation. PRIO is not based on legislation but is concerned with the intrinsic health properties and environmental properties of substances. PRIO is a tool for those who want to go further in their environmental work and be well prepared for future regulations. It helps in identifying chemical substances which, when the new EU legislation comes into force, will successively become subject to the authorisation procedure.
PRIO and the restricted substances database are two tools that complement each other. It is therefore not sufficient just to search in the PRIO database to find out whether there is legislation relating to a particular substance.
The PRIO tool applies to chemical substances of high concern as regards effects on health or on the environment. These high priority substances are in PRIO divided into two levels of prioritisation: phase-out substances and priority risk-reduction substances. The first group is termed phase-out substances. The substances in this group have properties of such concern that they should not be used. The properties that constitute selection criteria for this group reflect interim target 3 in the national environmental quality objective A Non-Toxic Environment. They also largely reflect the criteria for substances that may be listed as requiring authorisation within REACH, the new European chemicals legislation.
Phase-out substances:

- CMR (carcinogenic, mutagenic or toxic to reproduction), categories 1 and 2;
- PBT/vPvB (persistent, bioaccumulating and toxic/very persistent and very bioaccumulating);
- Particularly hazardous metals (mercury, cadmium, lead and their compounds);
- Endocrine disruptive;

Ozone-depleting.
Priority risk-reduction substances have properties to which special attention should be paid:

- Very high acute toxicity;
- Allergenic;
- Mutagenic (category 3);
- High chronic toxicity;
- Environmentally hazardous, long-term effects;

Potential PBT/vPvB.

The classification list is a database that comprises all substances and substance groups that have been classified and labelled jointly within the EU. It contains substances with differing degrees of hazard to health and the environment. The PRIO database is largely an extract from the classification list where the substances with the properties that are most hazardous in the long term are emphasised.

Voluntary actions

Besides legislative regulations, there are **voluntary initiatives** from the building sector whose aim is to reduce the environmental impact of the building sector.
In 1994, the Swedish government through its "Ecocycle Commission" established informal contacts with a number of representatives of the building and property sector grouped in a network "the Ecocycle Council for the Building Sector". Today's aim of the Ecocycle Council is, through voluntary efforts, to reduce the environmental impact of the building sector. A special program – the Environmental Program 2003-2010 was created. The Environmental Program contains objectives concerning chemical substances and indoor environments. Fading out hazardous substances: the use of hazardous substances within the Building Sector should be reduced to a minimum by the year 2010; latest by the year 2006 the main part (> ¾) of the relevant building products on the Swedish market should have building product declarations.
In the BASTA system (BASTA online), the Swedish construction sector has agreed on a common definition of the substance properties for the decision as to whether a product is to be accepted or not. The properties criteria are based on the properties identified in the forthcoming REACH regulation, plus the phase-out substances identified by the Swedish Parliament, lead, cadmium and mercury. These properties criteria are applicable to all types of construction products and apply to their properties on delivery to a construction site. They are stricter than the Swedish legislation and have been geared towards reducing the use of substances with particularly hazardous properties. The properties criteria mean that products must not contain chemical substances (above stated concentrations) with the following properties:

- carcinogenic substances;
- mutagenic substances;
- substances toxic to reproduction;
- persistent or very persistent substances;
- bioaccumulative or very bioaccumulative substances;
- sensitising substances;
- acutely toxic substances;

solvents.

Voluntary **labelling systems** are common in Sweden. The initiative for labels came from Non-Governmental Organisations. There are several label systems used for different products or for specific groups of persons, e.g. unperfumed soaps and laundry detergents for allergic persons. The label of Asthma and Allergy Association recommends the product, but says nothing about the product's environmental characteristics. The European Flower and the Nordic labelling system, the Nordic Swan, are also popular in Sweden.

Regulations of particular substances

Formaldehyde
Emissions from chipboard, plywood, fibreboard, blockboard and similar wood based panels containing formaldehyde based resins should not lead to concentrations exceeding 0.13 mg/m^3 according to Swedish Standard 27 02 36, based on testing in a 1 m^3 chamber.
Sweden has banned use of formaldehyde in cosmetics.

Triclosan
The Cosmetic, Toiletry and Household Products Association has come to an agreement with its members that they will not use triclosan in high-volume products such as dishwasher liquids and detergents (FORMAS, 2003).
Benzene
Content of benzene in toys or parts of toys may not exceed 5 mg/kg
Chemical products may not contain more benzene than 0.1 % of total weight.

Vinyl chloride
Prohibition for use as aerosol propellant

Trichloroethylene
The use of chlorinated solvents (dichloromethane, tetrachloroethene, tetrachloromethane, trichloroethane and tricholorothene) in consumer products is banned. Prohibition of professional use of trichloroethylene is effective since the 1st January 1996.
A complete prohibition on all use has not been however wholly effective. The ban created strong opposition among some users, who either found it particularly difficult to replace trichloroethylene or simply disapprove of the timing or policy method. Some firms spent a great deal of effort and resources in appealing and lobbying against the ban, and gather support from industry associations. The evidence shows that in most cases, substitution of other chemicals for trichloroethylene is relatively if not very cheap. Sterner and Slunge compared the ban in Sweden with policies applied in Norway and Germany (Sterner and Slunge, 2001; Sterner, 2003). Norway implemented a tax per kilo on both trichloroethylene and tetrachloroethylene. Germany has employed very tough technical requirements concerning emissions that apply to both trichloroethylene and tetrachloroethylene. As a result, the use of both substances has been drastically reduced in Germany and in Norway. In Sweden, the objective to eliminate trichloroethylene was not achieved, and the same or even better result could be obtained at lower cost when employing another kind of policy.

Brominated flame retardants
Sweden has banned the use of polybrominated biphenyls PBBs and tris(2,3dibromopropyl) phosphate (TRIS) in textiles intended to come in contact with the skin. This executive order is the implementation of EU directive 76/769.

PentaBDE & OctaBDE: according to the European directive 2003/11/EC, substances, preparations and articles with a concentration of more than 0.1 mass-% are interdict to be used or placed on the market.

In November 2004, the Swedish Chemicals Inspectorate (KEMI) issued a report in support of a national ban on decaBDE. The report concludes that decaBDE no longer is used by Swedish manufacturers, but may be imported into Sweden in articles. The report further concludes that the use of decaBDE is not required by fire protection standards and that alternative substances or methods are available to ensure fire safety. Finally, the report concludes that a national ban on decaBDE is appropriate based on the precautionary principle, and recommends that Sweden call for a continued ban on decaBDE in the RoHS directive (KEMI, 2004). The ecolabel systems, the TCO'95 and the Nordic Swan, restrict the use of BFRs.

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Sites containing information about indoor research programmes/projects executed in Sweden:

- FORMAS – have had a six year program- the healthy building – I enclosed a pamphlet about the program – for further information, www.formas.se
- MISTRA – overall env. research, have had a program about sustainable buildings, for further information - www.mistra-research.se
- Vårdal – research focusing on allergy, some projects have been about the indoor air/env. and allergy – for further information, www.vardal.se

Different Environmental Medicine Clinics at the county councils, for example in:
Lund, - www.ymed.lu.se
Gothenburg - www.vmc.ymk.gu.se
Uppsala - www.occmed.uu.se
Stockholm - www.folkhalsoguiden.se

Finland

The indoor air quality regulations in Finland are grouped in two categories: regulations for existing buildings and those concerning new buildings. The regulations concerning existing buildings are headed by the Ministry of Social Affairs and Health, whereas the legislation dealing with new buildings is coordinated by the Ministry of the Environment.
Various regulations dealing with building have been revised in the last few years to support ecologically sustainable construction. Campaigns and special programmes to increase the use of renewable resources have specifically promoted the use of wood in construction in order to improve atmospheric carbon dioxide levels.
The Finnish Government Programme for Ecologically Sustainable Construction has been drawn up by a team of experts at the Ministry of the Environment. The authorities and the construction and property sectors have expressed their commitment to co-operation in promoting practical measures to further sustainable development in their own fields.

Legislatorial regulations

In the matter of existing buildings, the role of the Ministry of Social Affairs and Health is to maintain good indoor air quality in homes, schools, offices and workplaces. The ministry has comprehensive legislation tools and functioning controlling systems on regional and municipal level. The Health Protection Act contains instructions and guidelines for physical, chemical and biological factors inside buildings. The Occupational Health Act establishes the requirements for indoor air quality in workplaces. The Radiation Act gives the guidelines and recommendations to avoid radon in dwellings.
The Ministry of the Environment is responsible for building legislation and air quality in new buildings. Construction activities in Finland are regulated under the Land Use and Building Act. The new act entered in force in the beginning of the year 2000. One of important aims of the act is to construct safe, healthy and comfortable buildings.
The Ministry of Environment issues the Building Code which contains binding regulations and guidelines for designing, building, construction work, ventilation, and indoor air quality (Ministry of the Environment, 2003). The chapter concerning air quality states that "buildings shall be designed and constructed in such a way that the indoor air does not contain any gases, particles or microbes in such quantities that will be harmful to health, or any odours that would reduce comfort". Apart from this general statement, the Building Code gives limit values for several substances:

Substance	Maximum allowed concentration
Carbon dioxide	2 160 mg/m^3 (1200 ppm)
Ammonia and amines	20 µg/m^3
Asbestos	0 fibres /cm^3
Formaldehyde	50 µg/m^3
Carbone monoxide	8 mg/m^3
Particles PM_{10}	50 µg/m^3
Radon	200 Bq/m^3
Styrene	1 µg/m^3

For other "impurities", the maximum permissible concentrations are fixed at 1/10 of the occupational exposure limits in the workplace air.

The most essential Finnish regulations on chemicals are Chemicals Act and Chemicals Decree. By means of Chemicals Act, chemicals hazardous to health or to the environment can be controlled when manufactured, imported, stored, placed on market, and used.

Selection of hazardous substances for the risk management

In 2001, the Finnish Environment Institute has proposed a national selection mechanism for hazardous substances and made a proposal for the first priority list of hazardous substances in Finland (Koivisto, 2001). In this context, the hazardous substances are persistent, toxic and tend to bioaccumulate (PBT) substances. According to the proposal, a substance must fulfil all three PBT criteria to be selected on the Finnish priority list. Persistency has been stressed in the selection profile, since it is considered as a particularly harmful character in the Finnish environmental conditions.

The selection mechanism has focussed on the environmental hazard, but most of the selected chemicals are of concern for the human health as well. The data on the harmful properties has been obtained from the Nordic Substance Database. The Finnish Register of Chemical Products (KETU) has been used as a pool of chemicals. The serious problem of this method is the lack of data. Only about 900 chemicals registered in KETU have information on persistency, toxicity and bioaccumulation, and can potentially be selected as priority chemicals. More than 4500 chemicals remain outside the selection. In addition, not all chemicals that exist on the Finnish market are included in KETU.

The proposal for priority list contained 54 industrial chemicals, 17 biocides, and 13 pesticides. In addition, separate lists of eight heavy metals and 37 endocrine disrupters were made.

The listed endocrine disrupters have been found in KETU and are identified as endocrine disrupters on the basis of EU candidate list. Several substances occur in more than one main category, e.g. several biocides are also used as industrial chemicals. Solvents are most common industrial priority substances, and other typical industrial use patterns are glues, resins, paints, lacquers, varnishes, lubricants and washing agents. Industrial priority chemicals are commonly used in chemical, metal, rubber and plastic industry. Also construction and car service are the fields where several products containing priority chemicals are used. Of the biocidal and pesticidal active substances, the insecticides are the most common. When regarding the number of products, most typical biocidal uses are antifouling paints and wood preservatives.

In 2003, the list was revised on the basis of comments received from the industry and other stakeholders. The substances were re-evaluated, and as a result the current proposal comprises 13 industrial chemicals, 6 pesticides and 3 metals (SYKE, 2004).

To be on the list does not necessarily mean a ban or restriction of the chemical. The priority list is intended to be used by all actors involved with manufacture, import or use of chemicals or products containing these chemicals to indicate that special care should be taken to reduce potential risks. The list may help to evaluate the hazard potential of chemicals and also to support the substitution principle. The priority setting mechanism and the proposed list are developed also for a tool to implement the requirements of EU water legislation regarding national identification of priority substances.

The proposed priority list cannot be complete. Therefore this kind of lists should always be considered as an example of particularly hazardous chemicals. As the amount of data on chemical properties is continuously increasing, the prioritisation should be repeated regularly.

Voluntary actions

Several actions have been taken to improve indoor air quality in recent years in Finland. One of the most important actions was introduction of the classification guidelines for indoor air quality and climate. This system called "Classification of Indoor Climate, Construction, and Finishing Materials" was founded by the Finnish Ministry of Environment in 1995. It is a voluntary scheme initiated by scientific community to supplement building codes. The guidelines were published by Finnish Society of Indoor Air Quality and Climate (FISIAQ) in 1995, and were revised in 2001 (FISIAQ, 2001). They include measurable target values, cleanliness requirements and emission criteria for building materials. At the beginning, the classification was aimed only for finishing materials, but since 2001, all construction materials can apply for the emission classification. Over 880 products fabricated by more than 110 producers now meet the low-polluting criteria (class M1), which makes approximately 20% of available materials.

The aim of the classification is to enhance the development and use of low-emitting building materials so that material emissions do not increase the requirement for ventilation. The classification presents requirements for the materials used in ordinary work spaces and residences. The Classification does not overrule official building codes or interpretations of them. At present, the system is independent from the industry and from the government. The government supported creating the labelling system, but didn't make publicity. In fact, the public was already aware of problems linked to indoor pollution (Jorma Säteri, personal communication).

A special guide was created to encourage healthier and more comfortable buildings. This guide describes three classes of building materials based on their total emissions of VOCs, formaldehyde and ammonia. To have healthier buildings, materials must be chosen from the lowest emission class.

Emission class M1 corresponds to the best quality and emission class M3 includes materials with the highest emission rates. Classified materials have to fulfil the following criteria at the age of 4 weeks:

	M 1	**M 2**
The emission of total volatile organic compounds (TVOC). A minimum of 70% of the compounds shall be identified.	< 0.2	< 0.4
The emission of formaldehyde(HCOH)	< 0.05	< 0.125
The emission of ammonia (NH_3)	< 0.03	< 0.06
The emission of carcinogenic compounds belonging to category 1 of the IARC monographs (IARC 1987)[1*]	< 0.005	< 0.005
Odour (dissatisfaction with odour shall be below 15 %)[2*]	Is not odours	Is not significantly odorous

1* IARC 1987, does not apply to formaldehyde (IARC 2004)

2* The result of sensory evaluation shall be > + 0.1.

Plasters and tiling products, levelling agents, putty, mastics, fillers, screeds and renders shall not contain casein. Emission class M3 includes materials whose emissions exceed the values specified for materials in category M2. Brick, stone, ceramic tile, glass, metal surfaces and wood hold a special status in the classification.

The classification of indoor air quality and of materials according to their harmful emissions has been now used for nearly 10 years. The system has proven to function well in practice. Buildings built with the best category S1 materials have also better air quality compared

with buildings where non-classified materials were used (Tuomainen et al. 2001). Since the classification was initiated, the manufacturers and importers of construction materials have improved the quality of their product so much that the measured emissions have decreased by the factor of thousand or more in some cases. Many domestic and foreign firms have developed new, low emission products by using improved technology, cleaner receipts, and laying more emphasis on product quality control.
This development and production of less emitting materials has also proved to be economically profitable. Although producing of better quality materials may require some extra cost, it is limited and negligible when compared with the life-cycle costs, and especially with the advantages better indoor quality gives to the users of the building. As soon as the manufacturers have realized that the extra costs are limited in comparison with advantages in the marketing of their products, they started to take an active part in the system (Kukkonen, 2003).
The labelling system in Finland is efficient because it is regarded as incitation of development, and a good indoor policy should promote development. Setting of targets is also important: it is better to establish good and very good quality criteria, not only minimum emission admissible. The idea to have three different levels of labels is not contradictory, and at the same time incites producers to improve their products.
At present, office buildings in Finland are built in good quality materials even if there is neither obligation nor recommendation to choose labelled materials for these buildings.

Regulations of particular substances

Formaldehyde

Particleboards, other wood-based products, furniture and insulation foam emitting formaldehyde. The formaldehyde content of room air is not allowed to be higher than 0.15 mg/m³ in air measured according to the Finnish standard SFS 3862.
M1-labelled materials at the age of 4 weeks shouldn't emit more than 0.05 mg/m^{2}h

D-limonene

Recommended indoor level based on potential respiratory irritation was established at 30 ppm

Brominated flame retardants

Polybrominated biphenyls are not to be used in textile articles, such as garments, undergarments and linen, intended to come into contact with the skin. These prohibitions are in accordance with EC Directive 83/264 which is implemented in EC Directive 76/769. Despite the lack of national activities, Finland has urged the restrictions of the use of brominated flame retardants in the OSPAR framework.

Chlorinated solvents

The following chlorinated solvents may not be used in chemicals intended for sale to the general public or for purposes outside industrial processes, such as cleaning of surfaces or textiles, when solvent content in the chemicals sold or used is 0.1 % or more by mass:

- chloroform;
- 1,1,2-trichloroethane;
- 1,1,2,2-tetrachloroethane;
- 1,1,1,2-tetrachloroethane;

- pentachloroethane;
- 1,1-dichloroethylene.

Ammonia
M1-labelled materials at the age of 4 weeks shouldn't emit more than 0.03 mg/m^{2}h

TVOC
M1-labelled materials at the age of 4 weeks shouldn't emit more than 0.2 mg/m^{2}h. A minimum of 70 % of the compounds shall be identified

Carcinogenic compounds belonging to category 1 of the IARC monographs (IARC 1987)
M1-labelled materials at the age of 4 weeks shouldn't emit more than 0.005 mg/m^{2}h

CFC (chlorofluorocarbons) and other ozone depleting substances
- chlorofluorocarbons (CFC);
- other fully halogenated chlorofluorocarbons;
- halons;
- carbon tetrachloride;
- 1,1,1-trichloroethane;
- methyl bromide;
- hydrobromofluoro-carbons (HBFC);
- hydrochlorofluoro-carbons (HCFC);

Decision of the Council of State 677/93, 891/92, 442/93, 508/91, 789/89, 962/89, 895/93 and 262/98 CFC and HCFC compounds and 1,1,1-trichloroethane and carbon tetrachloride, and products containing these substances, are banned for production, import, export and use.

Chromium and its compounds
The employer is not allowed to use building cement containing more than 2 mg/kg of water-soluble chromate. The chromate content is measured according to Finnish standard SFS 5183.

Penthachlorophenol
Pentachlorophenol is a synthetic chemical substance recognized as being dangerous for both man and the environment. Its classification and labelling, harmonized at Community level in accordance with Council Directive 67/548/EEC are as follows:
- classified as Category 3 carcinogenic;
- classified as very toxic by inhalation;
- classified as toxic by skin contact and by ingestion;
- classified as irritant to eyes, respiratory system and skin;
- classified as dangerous to the environment.

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France

The main policy instruments in France are regulatory tools for the use, interdiction or restriction of some molecules. Ministry of health (DGS, Direction générale de la santé) and Ministry of building and construction (DGUHC, Direction générale de l'urbanisme, l'habitat et la construction) are the two main authorities in charge of indoor environment quality measures. For the moment, product policy measures, and more generally indoor policy instruments, are rather scarce. Results of the undergoing national indoor air quality survey on the one hand, and the expected political decisions on the national organization linked to the future REACH program on the other hand, will probably lead in the next months to set up the product policy issue as a major issue.

Creating the Indoor Air Quality Observatory (OQAI) in 2001 was one of the major initiatives in the domain of indoor air quality in France. The Indoor Air Quality Observatory was funded by the Ministry of Construction and Housing, Ministry of Health, and the French Agency of Environment and Energy (ADEME). It is run by the Construction Science and Technique Centre (CSTB). The aim of the Observatory is to provide the necessary data for risk assessment and risk management related to exposure to indoor air pollution. Thus, the Indoor Air Quality Observatory fulfils one of the French National Environment and Health Action Plan (NEHAP) actions for indoor air: better understand the determinants of indoor air quality and strengthen regulations.

Prevention and reduction of health risks related to indoor air quality shall be conducted through four steps:

- prioritising pollutants;
- setting of concentration limits/guideline values;
- preparing recommendations for building materials;
- preparing recommendations for household products (furniture, paints, wood preservatives, aerosol sprays, cleansers and disinfectants, repellents and air fresheners,…).

The Indoor Air Quality Observatory conducted the first nationwide survey on indoor quality in dwellings. About 700 dwellings were investigated, and the results of analyses were used to establish a list of 70 prioritising pollutants including chemical and biological agents.

<u>Volatile organic compounds</u>

- Aromatic hydrocarbons: benzene, toluene, xylenes, 1,2,4-trimethylbenzene, styrene;
- Aliphatic hydrocarbons (n-C6 to n-C16): n-decane, n-undecane;
- Ccyclohexane;
- Terpenes: alpha-pinene, limonene;
- Glycols: 2-butoxyethanol (EGBE) and its acetate, 1-methoxy-2-propanol (2PG1ME) and its acetate;
- Halogenated hydrocarbons: trichloroethylene, tetrachloroethylene, 1,4-dichlorobenzene;
- Aldehydes: formaldehyde, acetaldehyde, hexaldehyde, acrolein.

Allergens
- Pets: Fel d1 and Can f1;
- Dust mites: Der p1, Der f1;
- Moulds: Alternaria alternata, Aspergillus fumigatus.

Particles
- PM10 and PM2.5;
- Ultra fine particles.

Other parameters
- Radon and gamma ray;
- CO_2;
- Temperature and humidity;
- Ventilation rate.

At present, there are only few regulations for non-occupational indoor air quality. They concern carbon monoxide, asbestos, radon, tobacco smoke and ventilation. Recently, there has been a strong public pressure on the government to establish guidelines for formaldehyde. For this reason, formaldehyde is one of the priority substances for which guidelines should be soon prepared. The other priority substances are: carbon monoxide, radon, asbestos, man-made mineral fibres and tobacco smoke.

In order to improve the health and environmental characteristics of building materials, the French government has decided to set up a labelling system. The system shall be promoted by the government by, for example, using labelled products in State building, and inviting the local communities to do the same, especially for schools. Consolidating a database on construction products shall help building companies and private persons choosing environmentally better products. At present, there are only 5 products in the database.

There are no specific criteria to directly verify the effectiveness of the indoor policy, but as far as indoor environment is concerned, the national environmental health action plan (called PNSE; June 2004) gives 3 criteria:
- carbon monoxide intoxication: 30 % reduction within 2008;
- 50 % building products with consumer information on health characteristics (indoor emissions) within 2010;
- 20,000 dwellings renovated each year.

France fully implemented the EU Directive 76/769 and its amendments.

Brominated flame retardants
France has implemented EC Directives restricting the use of tris(2,3-dibromopropyl) phosphate and PBBs in textiles.

Formaldehyde
French Décret n° 88/683 of 6 May 1988 and Arreté of the same date on the use of urea-formaldehyde foams in buildings intended for permanent or semi-permanent human occupation: the content of formaldehyde coming from wall insulated with urea-formaldehyde foams shouldn’t exceed 0.2 ppm per volume, in every room. (JORF of 08/05/1988)

Quantitative health risk assessment is currently undergone in France (participation of different institutes and agencies) and would eventually lead to new policy measures. Moreover, an indoor air quality **guideline** is currently being established and will be published in December.

Glycol ethers
4 glycol ethers are totally **forbidden**: methyl glycol (EGME) and ethyl glycol (EGEE) and their acetates (EGMEA et EGEEA) are forbidden in cosmetics and hygiene products, and in drugs (arrêtés des 22 et 27 janvier 1998, puis décision de l'AFSSaPS* du 24 août 1999 et arrêté du 7 mars 2002, et décision de l'AFSSaPS du 17 septembre 2004; * = French Agency for Drugs).

Benzene
Solvents and products shall not contain more than 0.1 % of benzene.

Hydrocyanic and hydrochloric acids
Arrêté of minister of interior of 04/11/1975, modified by the Arrêté of 01/12/1976, regulating the use of certain products and materials in public buildings. JORF of 10/01/1976 and 20/01/1977 In the internal installations of buildings accessible to the public , the use of the materials and products of synthesis such as the plastics, fibres and synthetic fibres, elastomers.

Radon
Indoor air **guidelines** (Circulaire DGS*/DGUHC** N°99/46 du 27 janvier 1999; * = Ministry of Health; ** = Ministry of Building and Construction): + 400 Bq/m^3 > short term remediation; +1000 Bq/m^3 > immediate remediation + public building closed. Moreover radon concentrations have now to be measured in public place (hospitals, day-care centers and schools) (arrêté du 22 juillet 2004)

Carbon monoxide
Specific national tool for a better detection of CO intoxications, a better prevention based on the surveillance of indoor combustion devices.

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http://rsein.ineris.fr = website of the RSEIN network (Recherche Santé Environnement Intérieur = Research on indoor environment and health), gathering more than 20 scientific partners working on indoor air quality (measurements, modelling, epidemiology, ventilation, health risk assessment). This network is financed by the ministries of health and environment and is coordinated by INERIS. A quarterly electronic newsletter (PDF file downloadable for free on the RSEIN web site) gives information (with analysis) on international publications and French studies and policies.

Germany

Introduction

In Germany, the Indoor Air Hygiene Commission (IRK) is the first actor in the topic of Indoor Air Quality. The Indoor Air Hygiene Commission (IRK) is a Federal Environmental Agency commission that was established in 1984 by the former Federal Health Agency (BGA). After the BGA's dissolution in 1994 and transfer of the BGA Institute for Water, Soil, and Air Hygiene to the Federal Environmental Agency in the same year, the IRK became an FEA commission. In 1992, the German Federal Government published it's first *"Konzeption zu Vebesserung der Luftqualität in Innenräumen" (Concept to Improve Indoor Air Quality).* This concept contained 13 main points that should be focused on:

- Bauprodukte – Construction Products;
- Ausstattungsmaterialien und Einrichtungsgegenstände - *Furnishing materials and furnishings;*
- Offene Flammen, Feuerstätten und Außenwandfeuerstätten - *Open flames, fire places and external wall fire places;*
- Raumlufttechnische Anlagen (RLT-Anlagen) - *Ventilation equipment;*
- Radon – *Radon;*
- Einfluss der Umgebung (Altlasten-Standorte, Straßenverkehr, gewerbliche Anlagen u.a.) – *Environmental Influence (e.g. Dumps, Traffic, Industrial Plants)*
- Putz-, Reinigungs- und Pflegemittel - Finery-, Cleaning- and Preservative agents;
- Mittel zur Ungezieferbekämpfung und Desinfektion von Holz-, Textilschutz sowie zum Schutz vor Zimmerpflanzen - *Products for vermin control and disinfection of wood, textile protection and to protect houseplants;*
- Gebrauchsartikel und Produkte des Heimwerker-, Hobby- und Bastelbereichs - Consumer products and products for do-it-yourselfers-, hobby- and tinkering area;
- Tabakrauch – Tobacco Smoke;
- Hausstaub, Mikroorganismen und allergisierende Stoffe – *House Dust, Micro Organisms and Allergenes;*
- Unsachgemäße Anwendung chemischer Stoffe und Produkte in Innenräumen - Inappropriate application of chemical materials and products in interiors;
- Luftverunreinigungen in Fahrzeuginnenräumen - *Air pollutions in vehicle Cabins.*

In 2004, a follow up report was compiled *"Verbesserung der Luftqualität in Innenräumen – Ausgewählte Handlungsschwerpunkte aus Sicht BMU" (Improvement of Indoor Air Quality – Selected Main Points of Action from the Angle of BMU).*

At present, questions about healthy Indoor Environment are managed in the framework of the action program Environment and Health (*"Aktionsprogramms „Umwelt und Gesundheit" - APUG).* The program is developed by the Federal Ministry of Environment and the Federal Ministry of Health.
Although there is no general legislation concerning Indoor Air Quality, a lot of legislative initiatives and actions have taken place in the past years in Germany. There are also private initiatives taken focused on improving the indoor air quality.

1 Legislation

The legislative actions are taken for the previously outlined action points. All in all, they can be divided in two main categories: guideline values for indoor air concentrations and measures taken to decrease the indoor concentrations of pollutants.

1.1 Guideline Values for Indoor Air

Guideline values for pollutants are available from international bodies (e.g. WHO) as indoor values, or also in Germany for use at workplaces (e.g. MAK). Being guidelines, these values have no legislative value but can only be used as indicators, taking into account conversion factors when needed. The IRK has established official limit values for indoor environments. There are two limit values: *Richtwerte I (RW I)*, and *Richtwerte II (RW II)*, where the latter one is derived from *Richtwerte I* by adding a factor (usually being 10). Guide value I (RW I) is the concentration of a substance in indoor air for which, when considered individually, there is no evidence at present that even life-long exposure is expected to bear any adverse health impacts. Values exceeding this are associated with a higher-than-average exposure that is undesirable for health reasons. For the sake of precaution, there is also need for action in the concentration range between RW I and RW II. At present, RW's are already established for eleven pollutants: toluene, dichloromethane, carbon monoxide, pentachlorophenol, nitrogen dioxide, styrene, mercury (as metallic vapour), tris(2-chloroethyl)phosphate, bicyclic terpenes (principal constituent alfa-pinene), naphthalene and aromatic hydrocarbon mixtures (C9-C14).
To take mixtures of different pollutants into account, rather then with concentrations for single pollutants, there are also values for TVOC given.
The working group did not consider establishment of a RW II value for diisocyanates (DI) useful, they quickly decrease and long-term exposure is not expected after hardening.

Table 5: Guideline Values for Indoor Air

Compounds	**RW II (mg/m^3)**	**RW I (mg/m^3)**	**Year of Set Down**
Toluene	3	0.3	1996
Dichloromethane	2 (24 h)	0.2	1997
Carbonmonoxide	60 (1/2 h)	6 (1/2 h)	1997
	15 (8 h)	1.5 (8 h)	
Pentachlorophenol	1 $\mu g/m^3$	0.1 $\mu g/m^3$	1997
Nitrogen dioxide	0.35 (1/2 h)	-	1998
	0.06 (1 Week)		
Styrene	0.3	0.03	1998
Mercury (as metallic vapor)	0.35 $\mu g/m^3$	0.035 $\mu g/m^3$	1999
Tris(2-chloroethyl)phosphate	0.05	0.005	2002
Bicyclic terpenes (principal constituent alfa-pinene)	2	0.2	2003
Naphthalene	0.02	0.002	2004
Aromatic hydrocarbon mixtures (C9-C14)	2	0.2	2005

1.2 Measures Taken to Decrease the Indoor Concentrations of Pollutants

In Germany, governmental actions have been taken on several fields. There is the construction related policy, pure chemical related policy, and measures taken to increase public awareness.

1.2.1 Legislation for Construction Products

Building products are major sources for indoor air pollution. Therefore, one of the major German programs to improve indoor air quality tries to improve (lower) the emissions of dangerous substances from building products.
This program is coordinated through the *"Ausschuss zur gesundheitlichen Bewertung von Bauprodukten"(AgBB- Committee for Health-related Evaluation of Building Products)*.

The AgBB Committee was founded in 1997 by the 'Working Group on Environment-related Health Protection' (Länderarbeitsgruppe "Umweltbezogener Gesundheitsschutz", LAUG) of the Permanent working Group of the Highest State Health Authorities (Arbeitsgemeinschaft der Obersten Landesgesundheitsbehörden, AOLG) of the Federal States (Länder). The Federal Environmental Agency acts as secretariat for AgBB. The goal of AgBB is to establish the fundamentals for a uniform and reproducible health-related evaluation of building products in Germany. The work of the AgBB is based on data of the *European Collaborative Action (ECA) "Indoor Air Quality and its impact on Man" (ECA Report nr. 18).*
To achieve its goal, the AgBB has developed a procedural scheme to evaluate the VOC-emissions from building products used for applications indoor. Within this scheme, volatile organic compounds include compounds within the retention range of C6 to C16, which are considered both as individual substances and as sum parameter following the TVOC concept (TVOC = Total Volatile Organic Compounds) – and semi volatile organic compounds (SVOC) within the retention range above C16 up to C22. At present, the applicability is been discussed with the involved parties. The Committee is confident that by adhering to the test values set in the scheme, the minimum requirements of the building codes for health protection with regard to VOC emissions can be met.
To assess the emissions, test chamber measurements have to be carried out. From these measurements, emission factors can be derived. These emission factors must be reduced to such a level that – assuming long-term occupancy of a room - emissions into the indoor air concentrations resulting from such emissions do not pose any threat to the health of sensitive persons even under unfavorable but still realistic assumptions (concerning product loading factor, air exchange rate and indoor climate). In practice, test-chamber concentrations should be below the pollutants' limit value being the LCI – values (Lowest concentration of Interest), which are published by the AgBB. Briefly, the scheme consists of two steps. A first step is an emission test after three days, were TVOC concentrations and the sum of detected carcinogens are assessed. An emission test after 28 days is the second step. Emissions of TVOC, SVOC, the sum of detected carcinogens, individual compounds with an associated LCI-value and the sum of al individual compounds without associated LCI value are successively assessed.
The German Institute for Civil Engineering (*Deutschen Instituts für Bautechnik – DIBt)* has implemented the AgBB scheme for the first time in August 2004 in the approval procedures for floor covering and floor covering adhesives. (601 textile floor covering, 602 resilient floor covering, 603 PVC – floor covering ,604 linoleum – floor covering, 605 floor coatings, 606 parquet / laminate floor covering, 608 polyurethane – floor covering, 609

polyolefin – floor covering). It means that products of these types are only admitted on the German market when they successfully pass all criteria of the evaluation scheme.

Table 6: Example of LCI-values (AgBB 2004)

	Substance	CAS	No. LCI [µg/m³]	EU classification	TRGS 900 or others [µg/m³]
1. Aromatic hydrocarbons					
1-1	Toluene	108-88-3	1.900	190.000	
1-2	Ethylbenzene	100-41-4	4.400	440.000	
1-3*	Xylene, mix of o-, m- and p-xylene isomers	1330-20-7	2.200	221.000	440.000
1-4*	p-Xylene	106-42-3	2.200	221.000	440.000
1-5*	m-Xylene	108-38-3	2.200	221.000	440.000
1-6*	o-Xylene	95-47-6	2.200	221.000	440.000

Other LCI values provided in the AgBB document (AgBB 2004)

Further criteria are laid down in the principles for the health assessment of construction products for indoor use of the DIBt. As an example the following list with rejection criteria for technical approvals is mentioned (Misch 2005):
T+ and T marked substances should be avoided;
Carcinogenic (T, R 45, R 49) und mutagenic (T, R 46) substances cat. 1 and 2 shall not be used intentionally;
Reused waste material shall be evaluated separately in an undiluted and unmixed form;
If waste wood is used the German „Altholzverordnung“ (provision for the handling of waste wood) shall be observed;
If inorganic waste is used the provisions of the LAGA (German waste authorities) shall be observed;
If organic waste is used emission tests shall be carried out where appropriate;
Formaldehyde: emission limit value < 0.1 ppm; for all construction products (if relevant);
Mineral fibers: certificate about the biopersistence according to ChemVerbotsV (German law for banned or restricted substances);
Benzo(a)pyren: limitation of the BaP-content to 5 ppm in the used bitumina for all bituminous materials;
Ceramic fibers: no use admitted if alternative materials are; available;
Polybrominated diphenylether: no use admitted as flame retardant;
Restriction of other substances possible depending on the chemical composition.

The Construction Products Directive (Council Directive 89/106/EEC) is converted into German national laws with the *“Bauproduktengesetz”* (BauPG-1992-08-10, Building Products Act). The German Building Products Act regulates how the Construction Products Directive, concerning the market introduction of building products, has been laid down in accordance with the German Model Building Code (*Musterbauordnung*) and the Building Codes of the States based to the latter.
Two sections of the German Model Building Code are dedicated to health- and environmental requirements:
Section 3: *Buildings must be designed, constructed and maintained in such a way that the public security and order, particularly life, health and the natural life conditions shall not be endangered.*

Section 13: *Buildings must be designed and fit for use in such a way that due to water, dampness, herbal or beastie varmints as well as other chemical, physical or biological impacts hazards or unacceptable nuisance shall not result.*
Based on section 17 of the Model Building Code, construction products can only be used in Germany when:

- They do not, or not substantially deviate from the regulated products that were known in the Technical Regulations from the Building Regulation List (*Bauregelliste A Teil 1*) published by DIBt and have got the Ü-mark or;
- They have an evidence of employability in form of:
    - A national technical approval (allgemeine bauaufsichtliche Zulassung) from DIBt;
    - A test certificate from an accredited body;
    - A separate approval from the highest Construction Supervision Authorities;

  This evidence is needed to cover the deviation from the technical construction prescriptions or to prove that the general technical specifications do not apply and the construction products have the Ü-mark or;
- When they can be used under the Construction Products Act or under the regulations of other EU-member states based on the Construction Products Directive or other EU – guidelines (on the condition they these regulations consider the essential requirements) and have a CE-mark based on the Construction Products Directive. The CE-mark also needs to show the German classes and the performance level for the product in question.

Building products that have given proof of compliance with the technical regulations, receive one of the three U-marks:

- ÜH: Certificate of compliance from the manufacturer;
- ÜHP: Certificate of compliance from the manufacturer, with preceding test from an accredited test body;
- ÜZ: Certificate of compliance from a accredited certification body.

1.2.2 Legislation Concerning Chemicals

In Germany, most European Directives concerning chemicals have been transformed in national regulation through the *"Chemikaliengesetz"* (ChemG – *Chemicals Act)*. Section 17 provides guidelines to protect humans and environment from harmful effects.

The *"Chemikalien-Verbotsverordnung*" (ChemverbotsV – *Chemicals Prohibition Act*) prohibits for instance the use of wood materials if they would produce an indoor concentration of formaldehyde higher then 0.1 ppm. At present other prohibitions exist for benzene (0.1 % mass content), mercury (metallic vapor), organotin chemicals, Polybrominated flame retardants, vinylchloride (propellant), pentachlorophenol (0.01 % mass content), tar oils or other limitations for carcinogenic, mutagenic substances and substances toxic for reproduction, when produced by building products.

1..2.3 Measures taken to increase public awareness

An important instrument for the improvement of indoor air quality is to raise public awareness. People that are well informed, are better able to protect themselves. Therefore the German Federal Environmental Ministry has published documents on specific topics.

Examples are the mould guidelines (“*Hilfe Schimmel im Haus”),* black soot deposition (“*Attacke des schwarzen Staubes”),* Indoor Air Quality in Schools (“*Leitfaden für die Innenraumlufthygiene in Schülgebäuden”*), Products for wood protection (“*Verbraucherleitfaden Holzschutzmittel”),* a general pamphlet about healthy housing (“*Gesünder wohnen – aber wie? Praktische Tipps für den Alltag”*). These documents can be consulted online (UBA or APUG)

The Ministry also operates a web based portal “*Lösemittelarm*” which provides information on low emission products.
The Ministry also supports the Ecolabel “*Blauer Engel” (Blue Angel).* The label already exists for almost 25 years and covers about 3600 products.

The Ministry ordered a feasibility study for settting up and maintaining public electronic databases in 2001: “*Ersellung eines Informationssystem für die Öffentlichkeit zu gesundheits-, umwelt- und verbraucherrelevanten Produktgruppen, Produkten und Chemikalien, Machbarkeitsstudie“*. Several databases can be consulted through website of the German Federal Institute for Risk Assessment.

1.2.4 Future Actions

In the Indoor Air Report of the German Federal Ministry (*Verbesserung der Luftqualität in Innenräumen),* an overview is given of the future actions to be taken.

1. Improvement of the self responsibility of the consumers and occupiers of the indoor rooms;
2. Tightening up of the chemical regulations (REACH);
3. Act for the Protection against Radon;
4. Investigation of the characteristics of the end-users;
5. Health-based requirements for building products;
6. Further developments for Indoor Air Guidelines and HBM (Human Biomonitoring) guidelines;
7. Analytical Quality Assurance;
8. Encouragement of cooperation between industry, science and environmental federations;
9. Research;
10. Strengthening of Indoor Air Hygiene as autonomous political domain.

2 Private actions

Next to the government, there are also private organizations that have published guideline values. The German working group of ecological research institutes (AGÖF) is an example of such private initiative. It’s a federation of independent consulting and service enterprises, which cooperate within the scope of interior air quality, pollutant measurements, ecological building and energy efficiency. Besides information on the topic of ecological constructions, they also provide indoor air quality guideline values for a limited selection of pollutants (e.g. asbestos, formaldehyde,..).

Table 7: Example of Agöf guideline values

Aromatics	CAS Nr.	Background value (µg/m³)	Normal Value (µg/m³)	Alarm Value (µg/m³)	Remarks
Benzene	71-43-2	1	3	6	Carcinogenic
Toluene	108-88-3	5	20	100	
Ethylbenzene	100-41-4	1	3	15	
m,p-Xylene	1330-20-7	3	10	30	
o-Xylene	95-47-6	1	3	15	

There are in addition several private labels the manufacturers can use to prove the quality of products. Examples are the natureplus label (AGÖF = ...), Emicode (GEV) or GUT (Gemeinschaft umweltfreundlicher Teppichboden e. V). There is an ECA report in preparation that provides an overview of all existing European emission labelling systems (ECA WG Report on Harmonisation of indoor material emission labelling systems in EU – part A).

Another action taken in the private field worth noticing, is the vehicle interior environment quality certification, initiated by Ford. The label is intended to replace all existing labels that are in use for vehicle interiors at present.

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California (USA)

Introduction

In the United States of America, the authority of taking product policy measures for improving indoor air quality is scattered over the different governmental bodies. The policy is being revised by different departments and agency's from both the federal government and the state governments.
Depending on the authorizing body, stress has been placed on voluntary programs. However, some regulations not actually intended to affect product pollutant emissions into indoor air do, however, apply and bring about some protections.
Following document will give a comprehensive, non-exhaustive, overview of policy measures to improve indoor air quality taken in the United States, with emphasis on California.

1 Legislation

1.1 Federal Legislation

Under the Clean Air Act, EPA (Environmental Protection Agency) sets limits on how much of a pollutant can be in the air anywhere in the United States. This ensures that all Americans have the same basic health and environmental protection. The law allows individual states to have stronger pollution controls, but states are not allowed to have weaker pollution controls than those set for the whole country. Public participation is a part of the 1990 Clean Air Act. Throughout the Act, the public is given opportunities to take part in determining the provisions of the law and how the law will be implemented. States can choose to accept the federal law and be responsible to the applicable Regional Office of the EPA, or they can adopt their own law and enforce it. Nevertheless, state actions are still subject to federal review and approval. For those states with their own air pollution control authority, one can take part in hearings on the state and local plans for preventing air pollution. One can sue the government or a source's owner or operator to get action when EPA or a state has not enforced the Act. The agency listed and regulated six chemicals through 1990. These are primarily ambient air pollutants and have not been identified and regulated specifically as indoor air pollutants. Compliance is based on monitoring stations that are intended to be representative of wide local or regional areas or "airsheds." The law also authorizes EPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment. EPA has promulgated NAAQS for six criteria pollutants (See 40 C.F.R. Part 50), Table 8. ***Primary standards*** set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. ***Secondary standards*** set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings

Table 8: National Ambient Air Quality Standards

Pollutant	Primary Stds.	Averaging Times	Secondary Stds.
Carbon Monoxide	9 ppm (10 mg/m^3)	8-hour[1]	None
	35 ppm (40 mg/m^3)	1-hour[1]	None
Lead	1.5 µg/m^3	Quarterly Average	Same as Primary
Nitrogen Dioxide	0.053 ppm (100 µg/m^3)	Annual (Arithmetic Mean)	Same as Primary
Particulate Matter (PM_{10})	50 µg/m^3	Annual[2] (Arith. Mean)	Same as Primary
	150 ug/m^3	24-hour[1]	
Particulate Matter ($PM_{2.5}$)	15.0 µg/m^3	Annual[3] (Arith. Mean)	Same as Primary
	65 ug/m^3	24-hour[4]	
Ozone	0.08 ppm	8-hour[5]	Same as Primary
Sulfur Oxides	0.03 ppm	Annual (Arith. Mean)	-------
	0.14 ppm	24-hour[1]	-------
	-------	3-hour[1]	0.5 ppm (1300 ug/m^3)

[1] Not to be exceeded more than once per year.
[2] To attain this standard, the 3-year average of the weighted annual mean PM_{10} concentration at each monitor within an area must not exceed 50 ug/m^3.
[3] To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 ug/m^3.
[4] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 65 ug/m^3.
[5] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

The 1990 Act includes a list of 189 hazardous air pollutants selected by Congress on the basis of potential health and/or environmental hazard; EPA must regulate these listed air toxics. The 1990 Act allows EPA to add new chemicals to the list as necessary. For instance, all products containing ozone destroying chemicals identified in the 1990 Act must be labelled by 2015.

The Toxic Substances Control Act (TSCA) of 1976 was enacted by Congress to give EPA the ability to track the 75,000 industrial chemicals currently produced or imported into the United States. EPA repeatedly screens these chemicals and can require reporting or testing of those that may pose an environmental or human-health hazard. EPA can ban the manufacture and importation of those chemicals that pose an unreasonable risk. TSCA's most recent amendments have provided specific emphasis on asbestos, indoor radon, and lead-based paint exposure. TSCA supplements other federal statutes, including the Clean Air Act and the Toxic Release Inventory under EPCRA (Emergency Planning and Community Right-to-Know Act).

The National Toxicology Program (NTP) was established in 1978. The program was created as a cooperative effort to: coordinate toxicology testing programs within the federal government, strengthen the science base in toxicology, develop and validate improved testing methods, provide information about potentially toxic chemicals to health, regulatory, and research agencies, scientific and medical communities, and the public. One of the documents published is the Report on Carcinogens (RoC).
The RoC is an informational scientific and public health document first ordered by Congress in 1978 that identifies and discusses agents, substances, mixtures, or exposure circumstances that may pose a hazard to human health by virtue of their carcinogenicity.

The RoC is published biennially and serves as a meaningful and useful compilation of data on:
The carcinogenicity (ability to cause cancer), genotoxicity (ability to damage genes), and biologic mechanisms (modes of action in the body) of the listed substance in humans and/or animals.
The potential for human exposure to these substances.
Federal regulations to limit exposures.
The current RoC contains information about 245 substances.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) section 104 (i), as amended by the Superfund Amendments and Reauthorization Act (SARA), requires ATSDR (Agency for Toxic Substances and Disease Registry) and the EPA to prepare a list, in order of priority, of substances that are most commonly found at facilities on the National Priorities List (NPL) and which are determined to pose the most significant potential threat to human health due to their known or suspected toxicity and potential for human exposure at these NPL sites. CERCLA also requires this list to be revised periodically to reflect additional information on hazardous substances. It should be noted that this priority list is not a list of "most toxic" substances, but rather a prioritization of substances based on a combination of their frequency, toxicity, and potential for human exposure at NPL sites. In the 2005 list, Arsenic is the toxic substance with the highest rank.

The U.S. Consumer Product Safety Commission is charged with protecting the public from unreasonable risks of serious injury or death resulting from more than 15,000 types of consumer products under the agency's jurisdiction. The CPSC is committed to protecting consumers and families from products that pose a fire, electrical, chemical, or mechanical hazard or can injure children. The CPSC has banned household aerosols containing vinyl chloride monomer for instance. They also have labelling requirements when products contain more than1 % formaldehyde. Other examples in reference nr.11

Federal law requires that before selling or distributing a pesticide in the United States, a person or company (registrant) must obtain registration, or license, from the U. S. EPA. Before registering a new pesticide, the U. S. EPA must first ensure that the pesticide, when used according to label directions, can be used with a reasonable certainty of no harm to human health and without posing unreasonable risks to the environment. To make such determinations, U.S. EPA requires more than 100 different scientific studies and tests from applicants. U.S. EPA works with registrants to develop labels (legal requirements for use) that describe the proper storage, handling, and application for each pesticide product. A labelling guide is available online:
(http://www.epa.gov/pesticides/regulating/labels/label_review.htm)
U. S. EPA performs similar actions for older pesticides under its re-registration program. Currently EPA is intending to develop a Reregistration Eligibility Decision (RED) for permethrin through a modified 4-phase public participation process that the Agency uses to involve the public in developing pesticide reregistration and tolerance assessment decisions.

The U.S. Department of Housing and Urban Development (HUD) has set limits for formaldehyde emissions from plywood and particleboard used in mobile homes in 1984. Test chamber concentrations are not to exceed 0.2 ppm and 0.3 ppm, respectively, to maintain and ensure indoor air concentrations of formaldehyde in mobile homes below 0.4 ppm [24 CFR 3280.308].

1.2 State of California - National Legislation

"Despite the significant health effects and potential economic impacts caused by indoor sources of pollution, there are few government standards restricting emissions from common sources of indoor pollutants, and there is no comprehensive program to protect air quality within residences, schools, or public and private buildings. A variety of agencies and organizations have established standards and guidelines that can be applied to limited aspects of indoor environments to assist in the assessment and control of health hazards from air pollutants." (ARB –Report to the legislation - Indoor Air Pollution In California)

With workplace standards, permissible exposure limits (PEL) and other limits can be set for airborne contaminants. However, those are designed to protect people 8 hours a day and 5 days as week and not to protect the general population.

The national ambient air quality standards, established by the ARB and US EPA, are designed for the protection of the general population but for outdoor means. They are often more protective then the federal AAQS. An example is the Guideline value for vinylchloride (24 hour – 0.01 ppm), since no federal standard exists.

Next to CPSC, ARB also sets consumer products standards in California. A first purpose is to reduce reactive VOC's to cause smog, and secondly ARB has prohibited the use of several toxic air contaminants in 13 categories of products. At present, regulations exist for antiperspirants, deodorants (17 CCR s 94502), consumer products, aerosol coatings and hairsprays. No antiperspirant shall contain CFC (set) or compounds that are listed as a toxic air contaminant (17 CCR s 93000), Table 9.

Table 9: Compounds that are Listed as Toxic Air Contaminant

Substance	Threshold Determination
Benzene	None identified
Ethylene Dibromide	None identified
Ethylene Dichloride	None identified
Hexavalent chromium (Cr (VI))	None identified
Asbestos [asbestiform varieties of serpentine (chrysotile), riebeckite (crocidolite), cummingtonite-grunerite (amosite), tremolite, actinolite, and anthophyllite]	None identified
Dibenzo-p-dioxins and Dibenzofurans chlorinated in the 2,3,7 and 8 positions and containing 4,5,6 or 7 chlorine atoms	None identified
Cadmium (metallic cadmium and cadmium compounds)	None identified
Carbon Tetrachloride	None identified
Ethylene Oxide (1,2-epoxyethane)	None identified
Methylene Chloride	None identified
Trichloroethylene	None identified
Chloroform	None identified
Vinyl chloride	None identified
Inorganic Arsenic	None identified
Nickel (metallic nickel and inorganic nickel compounds)	None identified
Perchloroethylene	None identified
Formaldehyde	None identified
1,3-Butadiene	None identified
Inorganic Lead	None identified
Particulate Emissions from Diesel-Fueled Engines	None identified

The Californian department of Pesticide Regulation (DPR) has set its own regulation for pesticides, above the federal US EPA regulation.

The Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) requires that the Governor revise and republish at least once per year the list of chemicals known to the State to cause cancer or reproductive toxicity. Businesses are required to provide a "clear and reasonable" warning when their products or actions may result in a release of chemicals above a specified threshold level, so that members of the public are aware they may be exposed to harmful chemicals.
The Office of Environmental Health Hazard Assessment (OEHHA) has set guidelines for outdoor pollutants that can be used as indicators for indoor air quality. At present chronic RELs (reference exposure levels) have been set for 80 pollutants, and acute RELs for 51 pollutants. Formaldehyde, for instance, has a chronic REL of 3 µg/m³, an acute REL of 9.4 µg/m³ and a special intermediate 8h indoor REL of 33 µg/m³.

Table 10: Examples of Chronic Reference Exposure Levels

	Substance (CAS#)	**Listed in CAPCOA -1993**	**Chronic Inhalation REL (µg/m³)**	**Hazard Index Target(s)**	**Human Data**
1	Acetaldehyde* (75-07-0)	☑	9	Respiratory system	
2	Acrolein (107-02-8)	☑	0.06	Respiratory system; eyes	
3	Acrylonitrile (107-13-1)	☑	5	Respiratory system	
4	Ammonia (7664-41-7)	☑	200	Respiratory system	☑
5	Arsenic (7440-38-2) & arsenic compounds	☑	0.03	Development; Cardiovascular system; Nervous system	
6	Benzene (71-43-2)	☑	60	Hematopoietic system; development; nervous system	☑
7	Beryllium (7440-41-7) and beryllium compounds	☑	0.007	Respiratory system; immune system	☑
8	Butadiene (106-99-0)		20	Reproductive system	

Complete list on website http://www.oehha.org/air/chronic_rels/allChrels.html

The Californian Department of General Services specified that all governmental building projects should include sustainable building measures. The minimal requirements are listed in Section 01350, Special Environmental Requirements, which provided protocols for testing of emissions of VOCs from building materials and furnishings to protect human health in state buildings. A guide is available from the Department of Health Services that updates the indoor air quality portions of Section 01350. The guide states that the emissions factors calculated from the small chamber tests for each of the identified chemicals of concern are then used to calculate the "modelled" indoor air concentrations for a standard office space or a classroom application using default ventilation rates, quantities (surface area, fault length, or units) of the material to be installed, and space volumes. Section 01350 requires that modelled indoor air concentration of any chemical 96-hours after the 10-day conditioning period, should not exceed half of the CREL, with the exception of formaldehyde. For formaldehyde, no single product's modelled concentration can contribute more than half of the total maximum 33µg/m³ (27 ppb) concentration limit for this chemical.

2 Measures To Increase Public Awareness

2.1 Federal Agencies

Several bodies of the United States of America's Federal government have published guides for informing, and improving indoor air. Examples are:

- EPA: The inside Story: a Guide to Indoor Air Quality";
- CPSC: Indoor Air Pollution: Introduction for Health Professionals;
- HUD: Help Yourself To a Healthy Home - Protect Your Children's Health

There are also several websites operated e.g. EPA (http://www.epa.gov/iaq/ia-intro.html) or USDA (http://www.csrees.usda.gov/ProgView.cfm?prnum=4356).

The U.S. EPA provides information on Healthy School Environments on a website, covering a broad range of topics, including indoor air quality.

2.2 State of California – National Actions

The ARB operates a web portal with indoor air quality guidelines for the general public. Currently, three indoor air quality guidelines have been published: formaldehyde, combustion pollutants and chlorinated hydrocarbons. The State of California Air Resources Board has just received the draft final report, Indoor Air Chemistry: Cleaning Agents, Ozone and Toxic Air Contaminants – from a study it sponsored regarding major investigations on building cleaning and maintenance products and their chemical reactions with ozone, a common outdoor air pollutant that is also brought into buildings by ventilation systems or emitted from some devices like photocopiers and certain air cleaners.

The Division of Environmental and Occupational Disease Control has it's portal of the California Indoor Air Quality Program. http://www.cal-iaq.org/.

The Californian Department of General Services directed the development of specifications for environmentally preferable janitorial products for the cleaning and maintenance of state-owned buildings.
The Collaborative for High Performance Schools publishes a list of products to meet section 01350 emission requirements. See website http://www.chps.net/manual/index.htm.

The California Department of the State Architect has started an online database with information on building products that are environmentally preferable products (EPP) for school construction. (http://www.eppbuildingproducts.org). The database can be consulted at no cost, but the present status is unclear (postponed?). 20 categories of products are included in the database, of which four categories already have been consulted and commented by stakeholders (e.g. public, industry,…).

3 Private actions

Guidelines and labels have been developed by several industrial and professional groups.

Labels for low emissions of e.g. formaldehyde are being developed and sustained by e.g. the Hardwood Plywood and veneer Association. The Carpet and Rug Institute (CRI) has

developed a new label (Green Label Plus) for compliance with the Californian Section 01350 requirements. Under the Green label plus, for example emissions of formaldehyde from carpets shall cause lower model chamber concentrations then 16 µg/m³ and 2.5 µg/m³ for 4-Phenylcyclohexene.

The Greenguard Environmental Institute has certification programs that prove low emission of about 2000 substances, including formaldehyde. A condition specific for the label is that any pollutant listed on the U.S. National Toxicology Program (NTP) –list will be reported.

The American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) provides standards for building ventilation rates that are also recommended by the Californian government.

Scientific Certification Systems (SCS), has an environmentally preferable products program and has been certifying Life Cycle Assessments for many years. They have also recently developed standards for emissions from indoor materials focusing on floor covering products including carpet and resilient floor coverings. http://www.scscertified.com/epp

Indoor Air Quality Certification - Indoor air quality is an important issue because most people spend as much as 90% of their time indoors at home, work, or school. Poor indoor air quality can be caused by a number of factors, including inadequate ventilation, poor cleaning, and excessive emissions of volatile organic compounds. (http://www.scscertified.com/iaq/index.html)
SCS also offers a certification program for Environmentally Preferable Products (EPP) to address the growing demand for products and services that have the least impact on the environment. Program development follows Executive Order 13101, which directs federal agencies and their contractors to identify and purchase products designated as "environmentally preferable." (http://www.scscertified.com/epp/)

The FloorScore program, developed by the Resilient Floor Covering Institute (RFCI) in conjunction with SCS, tests and certifies flooring products for compliance with indoor air quality emission requirements adopted in California. Flooring products include vinyl, linoleum, non-PVC resilient flooring, wall base, and associated sundries. (http://www.scscertified.com/iaq/floorscore.html)

Green Seal is developing standards to reduce emissions. Currently, they are focussing on governments (all levels) to use products wearing there label. One standard (GS-36) specifies e.g. that known carcinogens shall not exceed 0.1 % of the product mass

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OTHER COUNTRIES

Canada

The Consumer Product Safety Bureau of Health Canada administers the Hazardous Products Act (HPA) and Regulations, whose purpose is to protect the health and safety of the public by prohibiting or regulating the sale, advertising and importation of hazardous products. Some consumer product policies and regulations that protect the health and safety of the public from product-related hazards may also reduce and prevent indoor air pollution.
"Exposure Guidelines for Residential Indoor Air Quality", edited in 1997 by the Ministry of the Health of Canada (Health Canada), is a document specially prepared for indoor environments. The document gives the limit values of exposition for following substances: aldehydes, formaldehyde, carbon dioxide, carbon monoxide, nitrogen dioxide, sulphur dioxide, ozone, radon, particles, and water vapour. Biological agents, pesticides, lead, hydrocarbons and chlorinated solvents were classified as substances for which exact limit values could not be fixed. Recommendations how to avoid or limit exposure to these substances are however detailed in the document.

The consumer product-related policies that also relate to indoor air and reducing those specific pollutants identified in the questionnaire include the following:

1. Voluntary Agreement on Formaldehyde in Particleboard/Composite Panel Products.
2. Prohibition of Vinyl Chloride as a propellant in aerosol products.
3. Regulation for Lead in Candle Wicks.
4. Regulation for Mercury in Surface Coating Materials.
5. Initiatives for Air Cleaners Designed to Intentionally Generate Ozone (Ozone Generators).

In general, prevention of product-related hazards may be directed at protecting children and other vulnerable populations. For example, the warning on ozone generator indicated that *"persons with pre-existing lung diseases, such as asthma, are especially at risk and are warned not to use ozone generators in their homes"*.

Legislation on selected substances

Formaldehyde
Current indoor air guideline fixes two levels of formaldehyde: target level 50 ppb, and action level 100 ppb (Health Canada, 1987). The levels are currently being reviewed.
A Voluntary Agreement on Formaldehyde in Particleboard and Composite Panel Products:
In 1983, a voluntary standard was drafted between the Canadian Particleboard Association (CPA) and the Consumer Product Safety Bureau (CPSB) of Health Canada (then Consumer and Corporate Affairs). This program, monitored by the CPA, set the upper limit for formaldehyde release at 3 mg/mL, based on the two-hour desiccator test method. Continued monitoring of the program by the CCA had shown a decrease in formaldehyde over the years. As a result, the upper limit of formaldehyde release was reduced to 2 mg/mL in 1986. The test figures in 1991 show that the industry has maintained an average below 1.0 mg/mL of formaldehyde release, which is well below the limit.

In the mid-1990's, the CPA merged into the North American Composite Panel Association (NACPA). The NACPA has a different formaldehyde control and monitoring program, called "Grademark", which is an internal ASTM-registered formaldehyde testing and control program for the association's members.
As of 2005, CPSB and the NACPA have entered into negotiations to ratify the 1983 Voluntary Agreement, which would basically adopt the existing Grademark as the new, modernized agreement. It is expected to have these negotiations completed in 2005-2006.

Vinyl chloride
Prohibition of Vinyl Chloride in Aerosol Containers: since 1974, the Hazardous Products Act (HPA) prohibited the importation, sale and advertising of vinyl chloride in aerosol containers. Canadian industry had already abandoned the use of vinyl chloride aerosol propellants in 1972. The prohibition was developed to prevent the export to Canada from other countries where it was still being used or being considered for a ban.

Aldehydes
In the case of presence of several aldehydes in indoor air, the sum c1/C1+c2/C2+c3/C3 shouldn't exceed 1; c1, c2, c3 are the concentrations of respectively formaldehyde, acrolein and acetaldehyde measured during 5 minutes; C1, C2, C3 are:
C1 (formaldehyde) = 120 µg/m^3 (0.10 ppm)
C2 (acrolein) = 50 µg/m^3 (0.02 ppm)
C3 (acetaldehyde) = 9000 µg/m^3 (5,0 ppm)

Acetaldehyde
Guideline value: 9000 µg/m3 (5 ppm)

Acrolein
Guideline value: 50 µg/m^3 (0.02 ppm)

Carbon monoxide
Current IAQ guidelines: 1-hour 25 ppm, 8-hour 11 ppm

Nitrogen dioxide
Current IAQ guidelines: short-term (1-hour) 250 ppb, long-term 50 ppb

Ozone
Current IAQ guideline: 120 ppb
Ozone Generators: In April 1999, Health Canada issued a warning to the public not to use air cleaners that intentionally generate ozone (ozone generators) in their homes. Health Canada is concerned with the adverse health effects that may result from the deliberate exposure of the public to ozone from air cleaners that intentionally generate ozone gas. The direct and purposeful generation of ozone in indoor occupied spaces should be avoided.
Additionally, since June 2002, a moratorium on the certification and approval of ozone generators for residential use was implemented by certification organizations and electrical authorities for Canada. The moratorium means that electrically-operated household ozone generators are no longer being granted the necessary electrical certification or approvals. It is a violation of provincial electrical codes to sell products that are not certified or approved for Canada. Commercial and industrial use ozone generators are now subject to additional certification requirements and are not intended for sale to consumers for household use.

Health Canada is considering developing a regulation for residential ozone generators that are not already regulated under other pieces of legislation such as the *Food and Drugs Act* or the *Pest Control Products Act.*

It is anticipated that the above measures have reduced the number of ozone generators being sold for residential use in Canada.

Sulphur dioxide
Guideline value: 50 µg/m^3 (0.019 ppm)
Average concentration during 5 minutes: 1000 µg/m^3 (0.38 ppm)

Mercury in Paint
On May 4, 2005, Health Canada published in Part II of the Canada Gazette the Surface Coating Materials Regulations (le Règlement sur les revêtements) under the authority of the federal Hazardous Products Act (la Loi sur les produits dangereux). These Regulations restrict the total lead content of paints and other surface coatings to 600 mg/kg, with exceptions, and restrict the total mercury content to 10 mg/kg for all surface coatings.

Lead in Candle Wicks
On November 22, 2003, Health Canada pre-published in Part I of the Canada Gazette the proposed Candles Regulations (le Règlement sur les bougies). These Regulations are not yet in effect. However, they will restrict the total lead content of candle wicks or any other part of a candle to 600 mg/kg.

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Denmark

During the past 25 years Danish regulation on chemicals has been increasingly tightened. In 1999, a new strategy on chemicals was presented aiming at strengthening international co-operation, making the chemical industry more responsible, strengthening national regulation and enforcement, and increasing public access to information. The objectives were to reduce consumption of problematic chemicals, tighten control of chemicals and to work for a stricter chemicals regulation at both EU level and on a global basis. Work in these areas is still in process. Increasing responsibility of manufacturers and information for consumers also plays a crucial part.

National legislation

Danish building legislation consists of a Building Act and two sets of building regulations, one published in 1998 (chapter 6.4.2), applying to single-family dwellings and weekend cottages "Building Regulation for small dwellings", the other one is "The Building Regulations of 1 April 1995" (chapter 11.3.2). The purpose of building legislation is to ensure sufficiently high standards of safety and health in constructions.
The building regulations from the National Agency for Enterprise and Construction are enforced at all constructions, rebuilding and new use of buildings. The regulations (status as an executive order) can be found at http://www.ebst.dk/BR95/0/54/0.
At workplaces, the Executive Order on the Conditions at Permanent Places of Work No. 96 of 13 February 2001 issued by the Danish Ministry of Labour is active. English edition: http://www.at.dk/sw12389.asp. It contains several paragraphs relevant for indoor environment. Regarding substances see § 29.
In the Danish Building Regulations there are requirements concerning the health aspects, and on dangerous substances in respect to buildings. The manufacturer is responsible that his products fulfil the relevant regulations, but he needs the relevant information to be included in the harmonised standards. The municipalities are responsible for the administration of the Building Act and the Building Regulations in Denmark, and to some extent policing of the market will also take place through the competition situation. The Building Regulations contain recommendations for using the Danish Indoor Climate Labelling Scheme.
Danish regulation of the chemicals area is tightly bound to international agreements and, not least, to EU legislation. The overall responsibility for the field of chemicals rests with the Danish Environmental Protection Agency (Danish EPA), which is subordinate to the Ministry of Environment and Energy. Several other ministries also perform tasks in the chemicals area including, e.g., the Ministry of Labour, which regulates chemical substances in the working environment, and the Ministry of Food, Agriculture and Fisheries, which regulates chemicals in foodstuffs. Local councils and county councils monitor corporate discharges of chemical substances into the air and water.
In Denmark, the chemicals area is regulated by two acts in particular:

- The Environmental Protection Act, dating from 1974, covers releases into the air, water, soil and subsoil, of chemical substances that can be dangerous to the health or environment. The fundamental principle of this act is that substances that can pollute must not be released in the landscape. This act is also founded on the principle of the polluter paying the bill. In other words, the enterprise that causes the pollution is the one that must pay for its removal or for preventing its dissemination into the environment. The Chemical Inspection Service, which is a unit subordinate to the Danish EPA, has the task of helping to ensure observance of the regulations

governing the field of chemicals - including the importing of, and trading in, chemical products and substances in Denmark.

- The Chemical Substances and Products Act, from 1980, augments the Environmental Protection Act with regulations on the distribution, consumption and disposal of chemical substances. The purpose of this act is to prevent damage to the health and environment and to promote the use of cleaner technologies. This act concerns the clean chemicals, such as acetone, acetic acid and mineral turpentine, as well as convenience goods, such as cleaning products, paints and shampoos.

Last years, action targeting dangerous chemicals has been given high priority. The goal is to reduce the consumption of problematical chemicals. The problems caused by dangerous chemical substances extend across national boundaries, which is why Denmark gives high priority to the European and international efforts. Danish legislation covers the industrial use of chemicals, as well as the chemicals used in consumer products. Danish regulation is particularly strict in two areas, i.e., agricultural pesticides and biocides - substances which, although alien to the environment, are deliberately spread in the environment, e.g., to kill weeds, fungi and insects.
Agricultural pesticides and certain biocides must be approved by the Danish EPA before they can be sold and used. This applies to wood-protection products, rat poisons and insecticides.

Target areas

Over the coming years, Denmark will boost its efforts in the following areas:

- the consumption of problematical chemicals must be reduced. Work on restricting the use of dangerous chemicals must be intensified and a range of effective measures must be implemented;
- the control of chemicals must be heightened, increased responsibility must be laid on manufacturers, and consumers must be assured of access to information;
- EU regulations must be made more stringent and cohesive, while faster, simplified and more effective EU assessment procedures must be established; the Danish effort on behalf of effective global chemicals regulation must be reinforced.

Preventive action

Danish efforts in the field of chemicals will be applied according to the degrees of danger presented by chemical substances. The greatest efforts will be directed towards restricting the most harmful substances. Such substances include, e.g., substances that only degrade with difficulty in the environment, substances that accumulate in living organisms, and substances suspected of being carcinogens or hormone disrupters. Preventive action is gaining increasing prominence in the Danish regulation of chemicals.
Action plans, which typically combine several measures for limiting the consumption of a dangerous substance, will be drafted for specific target areas. In Denmark, action plans have been drafted, e.g., for PVC, phthalates and agricultural pesticides.

Danish product register

Often, neither the manufacturers nor the authorities are sufficiently knowledgeable about how the chemical substances are used and in which products they are included. Denmark and the other Nordic countries record such knowledge in their product registers. The Danish product register contains information on about 60 000 products. All of the information is

stored in a database and it is used to assess the risks presented to the environment and to the working environment by chemical substances and products. This enables the authorities to assign priorities in the preventive effort.
Today, only the dangerous chemical products used in commercial enterprises and agriculture are recorded in the product register. The basic idea is to extend the obligation to report such products to include all products classified as environmental hazards. Consumers must also be able to obtain information from the product register.

Measures to protect man and the environment from dangerous chemicals

Denmark applies a variety of measures to protect man and the environment from dangerous chemicals. The measures chosen depend on how dangerous a substance is, and how and where it is used and spread in the environment.

HARD MEASURES:

- Prohibition is an effective means of limiting the use of dangerous chemicals. Denmark has succeeded in reducing by 50 % its consumption of heavy metals (including cadmium and mercury) through prohibitions. A ban on ozone-depleting substances (e.g., Freon) has brought down consumption by 98 % over a ten-year period. In recent years, Denmark has issued prohibitions against the use of arsenic in impregnated wood, and has banned the use of irgarol and diuron (which are harmful to the aquatic environment) in bottom paints for boats. Denmark has also introduced bans on the use of phthalates in certain types of toy. Prohibitions and other restrictions are linked to the feasibility of finding effective alternatives to the chemical substances that are difficult to replace in manufacturing or housekeeping.
- Taxes are levied as a means of hastening manufacturers' efforts to replace dangerous substances with less dangerous alternatives. For instance, the fact that Denmark levies taxes on three chlorinated solvents (trichloroethylene, tetrachloroethylene and dichloromethane) has resulted in a 70 %-drop in consumption over three years. Taxes are also imposed on PVC and phthalates in certain products and the introduction of taxes on industrial greenhouse gases is now being considered. All products (including those that are imported) with a PVC content greater than 10 % of the product’s weight are taxed. The tax is apportioned to the PVC weight of the product, which rewards companies who minimize the use of PVC. The tax is reduced if the manufacturers established that the PVC does not contain any phthalates. A tax is also levied as a means of reducing the consumption of pesticides. This tax is used, e.g., to support research into alternatives to pesticides.
- Agreements with industry. The Danish environmental authorities are willing to enter into agreements on restricting dangerous substances with manufacturers and retailers. One example of this is an agreement with the manufacturers of washing and cleaning products on dispensing with nonylphenolethoxylates (NPEO) except in cases where it is impossible to find suitable substitutes. Further, the oestrogen-like substances used in agricultural pesticides, which are suspected of harming reproduction in humans, are being phased out during 2000, thanks to an agreement between the Danish EPA and the pesticides industry.
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SOFT MEASURES:

In recent years, the Danish EPA has focused more closely on such "softer" measures as the development of cleaner products, information campaigns and ecolabels. They are mostly used for chemical substances that do not cause serious damage to the health or environment.

- Development of cleaner products. Vital elements of the Danish environmental strategy include the designation of alternatives to the dangerous substances and the encouragement of manufacturers and importers to find substitutes and to develop alternative products. The Danish EPA's "Cleaner Products Support Programme" grants subsidies to a number of projects that promote replacement of the most undesirable chemical substances. This applies, e.g., to phthalates, lead compounds and the industrial propellant gases that contribute most to the greenhouse effect.
- Information campaigns must make enterprises, importers and consumers aware of the undesirable substances and how to avoid them. The emphasis is on information on the substances that are dangerous to the health and environment, and also on the substances that can be used instead of the dangerous ones. One example is impregnated wood. In Denmark, the use of wood impregnated with arsenic is forbidden. The Danish EPA therefore informs consumers about alternatives to impregnated wood, such as the most durable tree species and durable designs. Information on the chemical substances used in consumer products is another area that will be targeted in the future. The Nordic countries have drafted a common strategy, the goal of which is to phase out the most dangerous substances in consumer products over a 10-15 year period.
- Ecolabels are a high-priority area of Danish environmental policy. The EU ecolabel (the EU flower) and the Nordic ecolabel (the Nordic Swan) guarantee that a product satisfies certain environmental requirements and is one of the least harmful to the environment within its product group. Ecolabels are gradually gaining ground among Danish consumers - in particular, ecolabelled washing powders have improved their market share in recent years. And, in public procurements, e.g., of paper, ecolabelled goods are gaining a growing share of the market. There are around 1,300 ecolabelled (Nordic Swan or EU flower) products in Denmark at present - mostly in the category of paper goods. Ecolabels have also been awarded to such products as hard white goods, batteries and washing and cleaning products. Nordic Eco-Labelling system "Swan Label" is used in Nordic countries: Norway, Sweden, Finland and Denmark. In Denmark, Finland and Sweden, agencies of Nordic Label are incorporated into their national standardization organizations. Many companies at national and local governments have a purchasing policy requiring that products they purchase are labelled with the Swan or its equivalent.

Indoor Climate Labelling scheme initiated in Denmark in 1995 and adopted by Norway in 1998 a voluntary scheme though recommended by the building codes of both countries. Danish Indoor Climate Labelling (DICL) is a voluntary labelling scheme for the impact of building materials and products on the indoor climate. The purpose of the scheme is to improve the indoor climate in buildings by:

- Giving the manufacturers a tool to develop more indoor friendly products
- Giving the users a tool to select more indoor friendly products
- Giving everybody a tool for better understanding of the impact of products on the indoor climate

The Indoor Climate Labelling system receives strong national support and is recommended by the Danish Building Code

Green purchasing. Environmental information on products that lack hazardous chemicals is being prepared, to help public-sector buyers towards more environmentally-oriented procurement.

- List of dangerous substances.

This list contains the names of substances that have effects on health, the environment, are used in large quantities or are considered problematic by the Danish EPA for some other reason. Monitoring and information gathering on the most problematic substances is carried out continuously, so new substances can be added to the list and others can be removed, based on criteria such as toxicity, carcinogenicity, ability to cause genetic damage or impair fertility, allergenic features or negative environmental impact. The current list was last revised in 2004.

The fact that a substance appears on the list does not necessarily mean that it should be banned altogether, but it should be seen as a hint to either restricting the use to the lowest possible level or finding a more viable substitute.

The Danish-EPA has published two lists: “List of undesirable substances” (LOUS), and the “Effect list”. These lists include chemical substances, which are not banned but which are not desired in products, as they are considered to have a particularly severe impact on the health and environment. The substances on both of these lists have been chosen according to their inherent toxicity, and the substances on the 'undesirable list' have been chosen according to the amounts used. The lists warn enterprises, their product developers and their buyers of the substances for which they should be seeking alternatives, as it may be expected that the authorities will start to prohibit and/or in other ways regulate these substances. As its point of departure, the Danish EPA uses a list of about 6,400 substances (the "Effects List"), which are undesirable because of their effects on the health and environment. The most heavily used substances on that list are also included on the List of Undesirable Substances. A number of substances, which are especially problematical in marine environments, ground water or the waste cycle, are also included. In 2000, the Danish EPA has assigned special priority to 26 of the undesirable substances. Among these substances are: brominated flame retardants, formaldehyde, ethyl glycol and trichloroethylene.

The List of Undesirable Substances constitutes a warning of where the Agency will concentrate its efforts in the future. It should be part of the Requirements Specification how substances appearing on these lists should be handled by the Development. The substances are however not covered by any regulations. The first LOUS was published in 1998. It was also decided at that time that the task of monitoring and providing information on the most problematical substances would be carried out continuously.

The basis for selection of the substances is described in the reports "Criteria for selection of undesirable substances" (Working Report No. 71, December 1996) and "List of Effects 2000" (Environmental Review No. 6, 2000).

The List of Effects 2000 includes substances classified according to such effects as:

- high acute and/or chronic toxicity;
- carcinogenicity;
- ability to cause heritable genetic damage;
- ability to impair fertility;
- ability to induce allergy;
- environmental impact.

It is possible to limit the number of substances by assigning them priority according to their consumption on the Danish market. The Danish EPA has elected to apply a limit of 100 tonnes. Note that this does not mean that smaller quantities present no difficulties.

The specific use of a substance can constitute a considerable risk, even though the total quantity consumed in Denmark is limited.

The fact that a substance is included on the LOUS does not signify that the Danish EPA has decided to recommend prohibition of that substance. Regulations on total or partial prohibition are considered to be just one of many means of reducing the environmental loading caused by substances that have undesirable effects. Other means of restricting use include, e.g., classification and labelling, duties on particularly problematical chemicals, stricter standards, voluntary agreements on phase-out, environmental labels, green guidelines for purchasing, positive/negative lists for selected areas, subsidies for substitution initiatives, emission control and information campaigns.

Thus, the LOUS should be considered as a signal to, and a guideline for, the manufacturers, product developers, purchasers and other players concerned with chemicals, the use of which should either be restricted or stopped in the long term. This could be achieved by the companies involved which, based on the information of the LOUS, take the initiative to substitute the problematical substances themselves.

When substituting one substance for another, it is always vital to ensure that, apart from determining whether the alternative is actually usable from the technical standpoint, the substitute is less hazardous to the environment and health than the substance it replaces. Every effort should therefore be made to use alternatives, the effects of which have been studied and documented. It is also important to be aware of whether or not the environmental and health effects of the substitute will be of any significance to the product in which it will be used.

There is only product policy on a few specific pollutants. The main regulation is through general paragraphs in the executive order of permanent workplaces. Here it is stated, that building materials and surfaces in workrooms are not allowed to give off harmful substances in amounts, which are able to form unhealthy or annoying concentrations in workrooms. These and other paragraphs give the Danish Working Environment Authority ability to act in case of violations of these paragraphs, i.e. high concentrations of harmful substances in workroom.

The Danish legislation on carcinogenic substances prohibits the use of carcinogenic compounds, if a suitable alternative exists.

Regulations of selected substances

Formaldehyde
The formaldehyde regulation is fixed to the harmonised standard EN 13986 and class E1. It covers particleboards, other wood based products and insulation foam emitting formaldehyde. The regulation fixes the maximum emitted formaldehyde to 0.15 mg/m³ measured in a test room of 225 litres under standard conditions (Building regulation, 1995 Under Building Act, of Consolidation Act No 357 of 3 June 1993, Ministry of Housing - Notifications n° 95/188/DK and 95/67/DK and Building regulations for Small Buildings 1995, notification 97/0527/DK)
Sometimes it is impossible to document that the conditions have been met. In this case it is only permitted to use boards with a maximum free formaldehyde content of 25 milligrams per 100 grams dry substance in the board.

Alpha-pinene
Alpha-pinene is not classified in the list of dangerous substances but is adopted on the Danish EPA Effects list as: terpenes and terpenoids, turpentile-oil, alpha-pinene fraction. It is therefore considered as a substance potentially of concern to the health.

Methylene-di-isocyanate
The substance has problematic properties according to the List of Dangerous Substances. The Danish EPA considers carrying out studies of the significance of the use of this substance in consumer products.

Glycol ethers
The following glycol ethers are on the "List of unwanted substances" and/or the "Effect list" issued by the Danish EPA:
CAS: 1211-15-9;
ethylglycol - ethylène glycol éthyléther (EG - EGEE, CAS 110-80-5)
acétate méthyl glycol (EGMEA, CAS: 110-49-6)
méthylglycol (EGME, CAS: 109-86-4)
1- Propylène glycol 2- méthyl éther (1PG2ME, CAS: 1589-47-5)
1-Propylène glycol 2-méthyl éther acétate (1PG2MEA, CAS: 70657-70-4)

Trichloroethylene
It is on the "List of unwanted substances" and/or the "Effect list" issued by the Danish EPA.
In 1995 the Danish Parliament adopted a tax on the use of the most common chlorinated solvents (tetrachloroethylene, trichloroethylene and dichloromethane) to provide an incentive for reduced consumption, for instance by switching to less hazardous substances. The tax resulted in an approximate 25 % increase in the price of chlorinated solvents in Denmark when it was introduced. The tax is also levied on products that contain the specified chlorinated solvents.
After introducing the tax, the consumption of chlorinated solvents has fallen by approx. 60 % from 1995 to 1999. Ministry of Environment and Energy Statutory Order No. 1042 of 17 December 1997 on restricting the sale and use of certain dangerous chemical substances and products for specifically stated purposes, sections 27 and 28 are about chlorinated solvents.
The regulations cover chemical substances and products that contain one or more of the nine chlorinated solvents listed below (typically cleaning fluids):

chloroform,
tetrachloromethane,
1,1,1-trichloroethane,
1,1,2-trichloroethane,
1,1,1,2-tetrachloroethane,
1,1,2,2-tetrachlorethan,
pentachloroethane,
1,1-dichloroethylene.

It is not permitted to sell to the general public chemical substances and products containing 0.1 per cent by weight or more of chlorinated solvents. It is also not permitted to sell them for use in open systems, for example surface cleaning or to clean fabrics. Products must be labelled 'exclusively for industrial use'.

It is not permitted to use chemical substances which contain hexachloroethane, to manufacture or process aluminium, brass, or other metals that do not contain iron.

Brominated flame retardants
Use of tris(2,3-dibromopropyl) phosphate (TRIS) and application of PBBs to textiles implying skin contact are banned. This executive order is the implementation of EU directive 76/769.
Brominated flame retardants (as such) have been put on the Danish List of Undesirable Substances. BFRs have been selected to the list, due to high priority to the elimination of these substances in the marine environment.
Decabromodiphenyl ether and PBB are covered by Directive 2002/95/EC which prohibits the use of these substances in electrical and electronic equipment from 1 July 2006.

Cadmium and its compounds
Compounds used for soldering which contain more than 0.1 % cadmium are not allowed (Order n°183 of 15 May 1975 under the Working Environment Act n°646 of 18 December 1985, Ministry of Labour).

CFC (chlorofluorocarbons) and other ozone depleting substances
- chlorofluorocarbons (CFC);
- other fully halogenated chlorofluorocarbons;
- halons;
- carbon tetrachloride;
- 1,1,1-trichloroethane;
- methyl bromide;
- hydrobromofluoro-carbons (HBFC);
- hydrochlorofluoro-carbons (HCFC).

Commercial use of CFCs, tetrachloroethane, trichloroethane, halons, HBCFCs, HCFCs and methylbromide and sales of products containing more than 1 % by weight of these substances are prohibited as from 1.1.1998.
Some uses of HCFC are allowed for the following purposes until the dates given: hard plastic insulating foam for purpose other than district heating pipes after 1.1.2002 (notification 95/125/DK)

Chromium and its compounds
Consolidation Act 661 of 28 November 1983, under working Environment Act of Consolidation Act No. 646 of 18 December 1985, Ministry of Labour Regulate for a maximum chromate content in cement.

Some specific Danish legislation on materials
* Paint and laquers. The regulation fixes using a specified code number and maximum content of specified organic solutions.
Consolidation Act. N° 464 of 1982.08.03, under the working and Environment Act, cf. Consolidation Act No 646 of 1985.08.03, Ministry of Labour.
Regulations for Environmental Protection, cg. Consolidation Act No. 454 of 1991, 06.16 under the Act of Environmental Protection, Ministry of Environment.

* All materials which can be dangerous or which can endanger the safety or health. The regulation is a general requirement of substitute if possible.

Order No 540 of 1982.09.02 under the Working Environment Act, cf. Consolidation Act No 646 of 18 December 1985, Ministry of Labour.

* Glue and adhesive materials. Consolidation Act n°302, 13 May 1993 under Working Environment Act of Order n°646 of 18 December 1985.

* Materials containing resins of epoxy and materials containing isocyanate. The regulation fixes some coding procedures and how to use the materials. Order No 199 of 1985.03.26 under the Working Environment Act, of Consolidation Act No 646 of 1985.12.18, Ministry of labour.

* There is pressure from some EU governments, particularly Denmark and Germany, to ban the use of methylene chloride in paint strippers.

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http://www.mst.dk/indu/word/Redeg%C3%B8relsen,%20engelsk%20version.doc

Danish EPA () Discussion paper on Intensified Product-orientated Environmental Initiative, p. 190
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Fact Sheet No. 10: Formaldehyde in chipboard and similar
http://www.mst.dk/chemi/01071000.htm

Fact Sheet No. 18: Chlorinated solvents
http://www.mst.dk/chemi/01071000.htm

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http://www.mst.dk/homepage/

http://www.mem.dk/publikationer/red/gbred/ch4.htm

http://www.mst.dk/default.asp?Sub=http://www.mst.dk/udgiv/publications/2000/87-7909-568-2/html/kap04_eng.htm

http://www.mst.dk/news/07070000.htm

http://www.ebst.dk/BR95_10_ID198/0/54/0
www.retsinfo.dk

The Danish EPA have carried out and published a number of project mapping emissions of chemical substances from consumer products. Results available at www.mst.dk (also in English)
Some of the major can be found at:
http://www.ami.dk/Forskningsresultater/Indeklima.aspx
http://www.danishtechnology.dk/building/8913
http://www.ie.dtu.dk/
http://en.aau.dk/Research/Research+Centres%2C+Schools+and+Groups/555299

List of Undesirable Substances

Acrylamide
Certain alkanes and cycloalkanes
Alkylphenols and alkylphenol ethoxylates
Alkyl sulfonic acid phenyl ester
Benzenamine, N-phenyl-, styrenated
1,4-Benzenediamine, N,N'-mixed Ph and tolyl derivates
Biphenyl
Bisphenol-A
2,2'-Bisphenol F diglycidylether
Lead and lead compounds
Certain boric compounds
Certain brominated flame retardants
Butanone oxime
Cadmium and cadmium compounds
Certain chlorinated solvents
Chlorinated paraffins (short-, medium- and long-chained)
Certain chromate compounds
Cobalt(II)sulphate
Creosote compounds with carcinogenic "impurities"
Cyclohexane-1,2-dicarboxylic anhydride (unspec.)
Dibenzyltoluene
3,4-dichloroaniline
Diethanolamine
N,N-dimethylformamide
Ethanethiol
Fluorinated greenhouse gases (HFCs, PFCs and sulphur hexafluoride)
Formaldehyde
Formamide
Glutaraldehyde

2,3-epoxypropyl neodecanoate
Certain glycol ethers
Hexahydro-4-methylphthalic anhydride
Hydrocarbons, C4, 1,3-butadiene-free, polymd., triisobutylene fraction, hydrogenated
Hydroxybenzenes - hydroquinone and resorcinol
Hydroxylammonium sulphate
Certain isocyanates - MDI and TDI
Copper and copper compounds
Mercury and mercury compounds
4,4'-methylenedianiline
Mercaptobenzothiazole (MBT)
Molybdenum trioxide
MTBE
Sodium and calcium hypochlorite
Certain nickel compounds
4-nitrotoluene
Octadecyl 3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate
Octamethylcyclotetrasiloxane
Certain oil derivatives
Certain organo-tin compounds
Surfactants which do not degrade completely under low-oxygen conditions
Certain perfume ingredients
Pentaerythritol tetrakis(3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate)
PFOS compounds
Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-
Phenyl glycidyl ether
Certain phthalates
Phthalic anhydride, tetrahydromethyl- (unspec.)
Certain pigments and dyes
Propylene oxide
Styrene
Terphenyl (unspec.)
Thiram
Certain coal-tar products
1,3,5-tris(oxiranylmethyl)-1,3,5-triazine-2,4,6(1H,3H,5H)-trione
Triphenyl phosphite
Tris(2-chloroethyl)phosphate
Tris(2,4-ditert-butylphenyl) phosphite
Zineb

Poland

Poland was confronted to the indoor air problems quite early because in the beginning of years 70s. These problems were caused by materials impregnated with biocide pentachlorophenol that was used in big quantities to prevent fungal and microbial infestation of construction materials. In result, the air was polluted with chlorophenols, dioxins, and aromatic hydrocarbons. More than 10 000 flats and houses have been reconditioned with elimination of impregnated materials.

Confronted to many cases of indoor problems, the Government decided to organize a systematic control of indoor air quality, and of sources of pollutants in the indoor environments. Several measures have been undertaken:

The National Institute of Hygiene and Epidemiology has been appointed to attest health aspects of all building materials. Every year, about 2 000 building materials and products are evaluated from a health point of view. The evaluation is based on legal regulations issued by the Minister of Building and Building Materials.

Sanitary epidemiological stations, such as the State Sanitary Inspection, have to control the indoor environment, and determine health risk.

The National Institute of Hygiene and Epidemiology organizes training courses in the field of indoor environment protection, elaborates basic principles of testing building materials, and evaluates health risks and methods of indoor air examination.

A special Standard Committee has been funded in the framework of the Polish National Standard Organization with the main task of issuing standard methods of indoor air examination, e.g. for testing of acrilnitril, benzene, chlorophenols, formaldehyde, toluene, vinyl chloride.

On the basis of the building law, the Minister of Health and Social Welfare has issued a decree determining the maximum allowable concentrations of harmful substances in indoor air (Table 11). It also enumerates some very dangerous substances or mixtures, and determines their restrictions in building materials (a negative list) (Table 12).

This regulation rather unique in Europe and in the world sets two categories of rooms. Category A covers rooms designated for living, rooms designated for occupation by patients in health care buildings, and rooms for occupation by children in educational buildings. Rooms designated for occupation in public utility buildings, as well as auxiliary spaces in dwellings should meet criteria for category B (WHO, 1999).

Inspection and verification systems are non-existing or ineffective in Poland. Even in the case of buildings that obviously do not meet the requirements, the inspection system is not able to prove the fault and to punish the designer or builder.

Table 11: Maximum allowable concentration of harmful substances in indoor air

	Substance	Allowable concentrations [µg/m^3]	
		Category A	**Category B**
1	Acrylamide	1	3
2	Acrylonitrile	2	3
3	Ammonia	300	300
4	Benzene	10	20
5	Buthadiene	100	300
6	Buthanol	300	300
7	Chlorobenzene	15	40
8	Chlorophenols (without pentachlorophenol)	15	20
9	Chloronaphthalenes	15	30
10	Cyclohexane	250	250
11	Cyclohexanone	40	100
12	Dichlorobenzene	30	50
13	Ethylobenzene	100	150
14	Phenol	20	50
15	Formaldehyde	50	100
16	Dibuthylphthalate	100	150
17	Phthalate anhidrine	40	80
18	Ethylene glycol	15	50
19	Cresols	25	50
20	Xylene	100	150
21	p-cumene phenol	40	80
22	Maleinic anhidride	50	100
23	Naphtalene	100	150
24	Butyl acetate	100	150
25	Ethyl acetate	100	150
26	Vinyl acetate	50	100
27	Ozone	100	150
28	Pentachlorophenol	5	10
29	Mercury	1	3
30	Styrene	20	30
31	Carbon monoxide	3000	6000
32	Toluene	200	250
33	Trichloroethane	75	150
34	Trichloroethylene	150	200
35	Vinyl chloride	5	10

Note: Category A – exposure up to 24 h per day
Category B – exposure limited to 8-10 h per day

Table 12: Restrictions related to chemical substances or their mixture in building materials

	Name of substance	Limitation
1	Acrylamide and acrylonitrile	To be absent
2	Asbestos fibres	Ought to be absent as admixture
3	Benzene	Not more than 0.1 % in materials
4	Benzine and other organic solvent in products for injections into walls	To be absent
5	Chlorophenols	Ought to be absent in materials applied inside buildings
6	Chromate (CrVI)	Ought to be absent
7	Carbon tetrachloride	Ought to be absent
8	Mixture of aromatic hydrocarbons	Ought to be absent in materials applied inside buildings
9	Ethylene glycol	Ought to be absent in materials applied inside buildings
10	Cadmium as a pigment	Not to be used
11	Lindan	Ought to be absent as admixture
12	Methanol	Not more than 0.1 % in materials
13	Lead as a pigment	Ought to be absent
14	Lead as an anticorrosive factor	May be used only in industry buildings excluding food factory
15	Tar substances (from coal)	Only external application
16	Aromatic hydrocarbons (e.g. xylene, toluene, ethylbenzene) excluding benzene	Not more than 0.1 % in materials used inside of buildings
17	Chlorohydrocarbons excluding tetrachloride	Not more than 0.1 % in materials

References

Monitor Polski (1996) Order of Minister of Health and Social Welfare, 12 March 1996, regarding the allowable concentrations and intensity of factors harmful to health emitted from building materials and equipment in the rooms destined for human being. Monitor Polski 19: 231

WHO (1999) Strategic approaches to indoor air policy-making, pp. 105

Appendix 4: CD-ROM with Database

To be downloaded from the project website or on enclosed cd-rom (hard copy version)

Appendix 5: Presentation of Final Report

To be downloaded from the project website or on enclosed cd-rom (hard copy version)