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RESOURCE COMPENDIUM OF PRTR RELEASE ESTIMATION TECHNIQUES PART IV: SUMMARY OF TECHNIQUES FOR ESTIMATING RELEASES OF CHEMICALS FROM PRODUCTS

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PART IV: SUMMARY OF TECHNIQUES FOR ESTIMATING RELEASES OF CHEMICALS FROM PRODUCTS

Environment Directorate
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
Paris, 2017

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FOREWORD

With more and more countries developing PRTR programmes, it would be time consuming for a country to search for release estimation techniques (RETs) already established in other countries, and resource intensive to develop RETs on its own. The development of RETs can be considered a significant task for countries trying to implement a PRTR programme.

The OECD began work on the Pollutant Release and Transfer Register (PRTR) Release Estimation Techniques project in 1999. That same year, an expert workshop was held to: (1) identify what information is readily available on RETs for point and diffuse sources; and (2) recommend what can be done to improve the use and availability of such techniques. One of the recommendations from the workshop was to establish a Task Force to manage OECD work in this area. The Task Force on PRTRs was established in 2000 under the auspices of the Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, Pesticides and Biotechnology.

The work programme of the Task Force calls for the development of several technical documents to provide governments and industry - as well as others who are interested in this issue - with information and practical guidance for identifying, selecting and applying different techniques for estimating pollutant releases from point and diffuse sources and from transfers. The *Resource Compendium of PRTR Release Estimation Techniques* – which includes a number of Parts - is the first in a series of documents created to help accomplish this goal. The intent of this Resource Compendium is to provide countries with a basic information resource on estimation techniques that are used (or are expected to be used) in calculating pollutant releases from point and diffuse sources, transfers and products.

The *Resource Compendium* consists of four separate volumes:

- Part 1: Summary of techniques used to quantify releases from point sources, published first in 2002, and updated in 2013[ENV/JM/MONO(2002)20/REV1],

- Part 2: Summary of techniques used to quantify releases from diffuse sources, published in 2003 [ENV/JM/MONO(2003)14]

- Part 3: Summary of techniques used to quantify the amounts of chemicals found in transfers, published in 2005 [ENV/JM/MONO(2005)9].

- Part 4: Summary of techniques used to calculate the release amounts of chemicals contained in products, published in 2011 [ENV/JM/MONO(2011)7/PART1, ENV/JM/MONO(2011)7/PART2]

This document is an updated version of Part 4. It was originally published in 2011 and has been updated to reflect new and additional information.

How this document was developed

The Nordic PRTR Group (Finland, Sweden, Norway and Denmark) took the lead to develop and revise the Resource Compendium of PRTR Release Estimation Techniques. The Finnish Environment Institute coordinated a series of several projects funded by the Nordic Council of Ministers, compiled the documents and prepared most of them. Statistics Sweden (SSB), the Norwegian Environment Agency and the Swedish Environmental Research Institute IVL contributed by sharing their outstanding knowledge in the field and writing part of the case studies and RETs. The drafting was supported by valuable comments from the OECD Task Force on PRTRs and the Task Force on Exposure Assessment.

Since 2003, the Nordic PRTR Group has paid attention to the lack of product use related information in PRTRs, and has carried out four projects to collect available information on releases from products. The projects have been funded by the Nordic Council of Ministers' (NCM) Product and Waste Group (2008-2009) and Chemicals Group (2010 and 2012-2014). In 2012 the Nordic PRTR Group started an initiative to further develop RETs for selected product groups and chemicals and to present the RETs in a way that they can be used to include releases from products into national inventories. The work was carried out with the support received from the Nordic Council of Ministers.

This second version of the Resource Compendium combines the results of the further work on releases from products carried out in 2012-2014 in the Nordic PRTR Group with the earlier information. The purpose of the work was to collect additional information on releases from the public and private use phase of some selected products and articles, to further clarify the challenges in estimating such releases, and to re-evaluate and develop new RETs.

Material from different studies carried out in the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden) has been the main source of this document. Additional information from work performed in Japan, the Netherlands and the United States has been included as far as material was available. Also, information from the work carried out by international organizations and references found in the literature has been included where possible.

How to use this document

The aim of this document is not to make specific recommendations on preferred estimation techniques; rather, it is to provide a catalogue of release and transfer estimation techniques available and to summarise the pertinent information needed to apply them. Another aim of this project is to provide a listing of reports and other documentation describing the various methods being used in OECD countries to estimate releases of pollutants to air, water, and land.

When reading the report, it needs to be kept in mind that

1. The lists of chemicals and product groups presented in this study are not comprehensive, but reflect information that was available by the end of 2014.

2. Quantification of releases from products is a new and developing area and therefore the data, calculation methods and conclusions presented in this document would need to be updated as new research results become available. In addition, uncertainties for the existing RETs are high. Country-specific use conditions and practices need to be considered when applying products into PRTRs.

3. New initiatives to improve information on chemicals in products or register releases from products are under way (e.g. in the European Union and at international level, for instance UNEP).

4. Releases from the historical use of products may still play an important role.

The reader is advised to familiarize him/herself with the terminology, the definitions as well as the background and the results of the previous projects in this area. For example, in this document, the word "product" is used for mixtures (e.g. chemicals in a container such as paint and glue) as well as articles that may be used outside industrial activities, i.e. publicly or privately in households, such as for instance, brake linings in cars, tyres or flooring materials.

This document should be seen as a 'living' document, which provides the most up-to-date information available. It can be updated periodically to include new information. Users of the document are encouraged to submit comments, corrections, updates and new information to the OECD Environment, Health and Safety Division (ehscont@oecd.org). The comments received will be forwarded to the OECD Task Force on PRTRs, which will review the comments so that the document can be updated accordingly.

This document is published on the responsibility of the Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, Pesticides and Biotechnology of the OECD.

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ABBREVIATIONS AND ACRONYMS

Organisations

AKE	Finnish Vehicle Administration
AMAP	Arctic Monitoring and Assessment Programme
AQSIQ	General Administration of Quality Supervision, Inspection and Quarantine of China
CEPR	Centre for Emergency Preparedness and Response
CLPEU	regulation on Classification, labeling and packaging
CLRTAP	Convention for Long-Range Transboundary Air Pollution
CPA	Clean Production Action group in the US
CPSC	U.S. Consumer Product Safety Commission
DG SANCO	Health and Consumer Protection Directorate-General of the European Commission
DMU	Danish Environmental Research Institute
DSB	Swedish Directorate for Civil Protection and Emergency Planning
EC	European Commission
ECB	European Chemical Bureau
ECC	European Consumer Centres Network
ECHA	European Chemicals Agency
EEA	European Environment Agency
EEC	European Economic Council
ELV	End-of-life vehicles (EU Directive)
EPR	Extended Producer Responsibility
EMEA	European Medicines Agency
EMEP	European Monitoring and Evaluation Programme
ESPA	European Stabiliser Producers Association
EuPC	European Plastics Converters Association

EU	European Union
EVIRA	Finnish Food Safety Authority
EWG	Environmental Working Group in the US
HCWH	Health Care Without Harm
HBN	Healthy Building Network in the US
HELCOM	Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area
ICCA	International Council of Chemical Associations
ICCM	International Conference on Chemicals Management
IFCS	Intergovernmental Forum on Chemical Safety
ILA	International Lead Association
ILZSG	International Lead and Zinc Study Group
IVL	Swedish Environmental Research Institute
IPEN	International POPs Elimination Network
ISO	International Organization for Standardization
KemI	Swedish Chemicals Agency
MST	Danish Ministry of the Environment
NCM	Nordic Council of Ministers
NGO	Non-governmental Organizations
OECD	Organisation for Economic Development
OEWG	Open-Ended Working Group (in the US)
ORRChem	Swiss Ordinance on Risk Reduction related to Chemical Products
OSPAR	Oslo Paris Convention on the protection and conservation of the marine environment of the North-East Atlantic
PCFV	Partnership for Clean Fuels and Vehicles (UNEP)
PRTR	Pollutant Release and Transfer Register
REACHEU	regulation concerning registration, evaluation, authorisation and restriction of chemicals
RoHs	Use of certain hazardous substances in electrical and electronic equipment (EU Directive)

SAICM	Strategic Approach to International Chemicals Management
SCB	Statistics Sweden
SNV	Swedish Environmental Protection Agency
SSB	Statitics Norway
SYKE	Finnish Environment Institute
TEM	Ministry of Employment and the Economy, Finland
TUKES	Finnish Safety Technology Authority
UNECE	United Nations Economic Commission for Europe,
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention for Climate Change
VALVIRA	Finnish Supervisory Authority for Welfare and Health
VECAP	European voluntary emissions control action programme
WEEE	Waste Electrical and Electronic Equipment (EU Directive)
WFD	Water Framework Directive
WHO	World Health Organisation

Concepts

API	Active pharmaceutical ingredient
Article (in REACH)	An object which during production is given a special shape, surface or design that determines its function to a greater degree than does its chemical composition
BEST	Better Environmental Sustainability Targets
CE	Conformité Européene (product marking to confirm compliance with EU Product Directives)
CMR	Carcinogenic, mutagenic, reprotoxic
CPD	Construction Products Directive
ECA	Electrically conductive adhesives
EF	Emission factor
GADSL	Global Automotive Declarable Substance List

GDSN	Global Data Synchronisation Network
GHS	Globally Harmonized System (GHS) for classification and labelling
GPC	Global Product Classification of chemicals
GPHIN	Global Public Health Intelligence Network
GPS	Global Product Strategy
GPSD	General Product Safety Directive
HPV	High Production Volume
IMDS	International Material Data System
IMERC	Interstate Mercury Education and Reduction Clearinghouse in the US
IPP	Integrated Product Policy in the EU
IUCLID	International Uniform Chemical Information Database
LIPASTO	Calculation system for traffic exhaust emissions and energy consumption (Finland)
LCA	Life-cycle analysis
MSDS	Material safety data sheet
NA	Not available
NEC	National Emissions Ceilings (EU Directive on NEC)
NLFWWI	National Lead Free Wheel Weight Initiative
PPCPs	Pharmaceuticals and personal care products
ppm	Parts per million
RET	Release Estimation Technique
RAPEX	Rapid alert system for non-food consumer products in the EU
RCGC	Responsible Care Global Charter
SRD	Source Ranking Database (by USEPA)
SIN List	Substitute It Now
SLI	Starting, Lighting and Ignition (batteries)
SPIN	Substances in Preparations in the Nordic Countries

SVHC	Substances of very high concern
WSSD	World Summit on Sustainable Development
WWTP	Wastewater Treatment Plant

Chemicals and substances

APEO	Alkylphenol ethoxylate
Ag	Silver
As	Arsenic
BBP	Butyl Benzyl Phthalate
BDE	Bromodiphenyl ether (deca-/penta-/octa-)
BFR	Brominated Flame Retardants
BMDBM	Butyl methoxydibenzoylmethane
BP3	Benzophenone-3
BPA	Bisphenyl-A
BRF	Brominated flame retardants
Ca	Calcium
CCA	Chromated copper arsenate
Cd	Cadmium
CFC	Chorofluorocarbons
CMR	Carcinogenic, mutagenic or toxic to reproduction (reprotoxic)
CO	Carbon monoxide
CP	Choroparaffins
Cr	Chromium
Cu	Copper
D5	Cyclopentasiloxane, decamethyl
DBP	Di-n-butyl phthalate
DDT	Dichloro-diphenyl-trichloroethane

DecaBDE	Deca-Bromodiphenyl ether
DEHP	Di (2-ethylhexyl) phthalate
DHTMAC	Bis(hydrogenated tallow alkyl) dimethyl ammoniumchloride
DIDP	Di-isodecyl phthalate
DINP	Diisononyl phthalate
DMF	Dimethylfumarate
DNOP	Di-n-octyl phthalate
DODMAC	Dimethyldioctadecylammonium chloride
DODP	Dodecyldiphenylphosphine
DSDMAC	Disterayldimethylammonium chloride
DTDMAC	Ditallow dimethyl ammonium chloride
EHMC	Ethylhexyl methoxycinnamate
FTOH	Fluorotelomer alcohols
GHG	Greenhouse gas
HBCD or HBCDD	Hexabromocyclododecane
HCB	Hexachlorobenzene
HCBD	Hexachlorobutadiene
HCFC	1,1-dichloro-1-fluoroethane
HCH	Hexaclorocyclohexane
HCHO	Formaldehyde
HFC	Hydrofluorocarbon
Hg	Mercury
LA	Lead Arsenate
LAS	Liquid Ammonium Sulfate
MBC	Methylbenzylidene camphor
MCPA	2-Methyl-4-chlorophenoxyacetic acid

MCCP	Medium-chained chlorinated paraffin
NH3	Ammonia
Ni	Nickel
NMVOC	Non-methane volatile organic compound
NPs	Nonylphenyls
NO_x	Nitric oxides
NP/NPE	Nonylphenol/nonylphenol ethoxylate
OC	Organic carbon
OBDE or octa-BDE	Octabromodiphenylether
OPs	Organophosphates
PAA	Polyaromatic amines
PAH	Polycyclic aromatic hydrocarbon
Pb	Lead
PBB	Polybrominated biphenyl
PBDE	Polybrominated diphenyl ethers
$PbHAsO_4$	Lead arsenate (LA)
$PbCO_3$	Lead carbonate, cerussite
PbO	Lead oxide
PbS	Galena, Lead sulfide
$PbSO_4$	Lead sulphate, anglesite
PBT	Persistent, bioaccumulative and toxic
PCB	Polychlorinated biphenyl
PCDD/F	Polychlorinated dibenzodioxin/furan
PCN	Polychlorinated naphthalene
PCP	Pentachlorophenol
PeCB	Pentachlorobenzene

PE	Polyethylene
PBDE or penta-BDE	Pentabromodiphenylether
PFAS	Perfluoroalkyl substances
PFCs	Perfluorinated chemicals
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulphonate / Perfluorooctanesulfonic acid
PM	Particulate matter
POP	Persistent Organic Pollutants
PVC	Poly Vinyl Chloride
SAC	Tin-silver-copper solder
Sb	Antimony
SCCP	Short-chained chlorinated paraffin
Sn	Tin
SO_2	Sulphur dioxide
SVHC	Substances of very high concern
TBBPA	Tetrabromobisphenol A
TBT	Tributyl *tin*
VOC	Volatile Organic Compoulds
vPvB	Very persistent and very bioaccumulative
XPS	Xtrudert polystyrene
Zn	Zinc

EXECUTIVE SUMMARY

Background

Key aspects of any Pollutant Release and Transfer Register (PRTR) programme are the estimation techniques used to generate data on releases from point and diffuse sources, and on transfers to off-site treatment. Companies that report data to a national PRTR generally estimate releases with, for example, emission factors or mass balance calculations, rather than submitting results of specific continuous monitoring data. As different industrial processes and activities involve different throughputs, equipment and operating conditions, different methods for estimating pollutant releases and transfers are required.

However, the development of new release estimation techniques (RETs) can be extremely resource intensive, as can the identification and collection of techniques from other countries. To help reduce costs to Member countries, the OECD was asked to collate information on RETs and transfer estimation techniques and to make them widely available.

While restrictions on releases to the environment from industrial activities, transportation and agriculture have led to decreased releases from these sources, there are other sources that may still generate considerable releases even with increasing trends. According to many studies, the proportional and actual releases from the use of products have increased during the past decades due to the continuously growing number of chemicals and products in use. This means that a large part of the national total releases of certain substances may already be from products, however, the knowledge base on this subject is still insufficient.

The scope of this document is to identify relevant releases to the environment from the use phase of end-products, to present techniques to quantify the releases, as well as to provide information on how to include these releases into PRTRs.

Contents

This Resource Compendium comprises two parts.

This main body provides information on activities by countries and different organisations in their efforts to identify, classify, quantify and restrict releases arising from the use of products (Chapters 2-4). Then, information on likely releases generated during the use of products is compiled in Chapter 5. Chapter 6 provides a general introduction to release patterns and Chapter 7 introduces available RETs for releases from the use phase of end-products as well as a list of potential product groups for inclusion into national PRTRs. Issues to be taken into account when considering the inclusion of releases from products into PRTR registers as well as recommendations on product groups to be included are compiled in Chapter 8.

In the Annex, product group and chemical-specific RETs are provided for eleven case studies. A compilation of recommended calculation methods for PRTR reporting are also presented.

1 INTRODUCTION

1.1 Background

1.1.1 Global aspects

As products are used everywhere in society, direct releases to air, soil or water may occur anywhere. The product type, use patterns and waste management systems for used products vary in the different parts of the world as does the legislation that targets chemicals in products. Though accurate quantification of releases from the use-phase of products is not yet routine work in countries, there is a clear indication that a large part of the national total releases of certain substances may be product-based in many countries.

The globalisation of the world economy brings further challenges to the understanding of chemical releases from the use of products due to the variety and number of different products, differences in the composition and chemical contents of similar products, use and disposal patterns of products in the different parts of the world, their numbers and the chemical contents of each product, and how they move around the globe (Figure 1).

Figure 1. Releases from products are globally shared

Although restrictions would apply to the chemical contents of domestically manufactured and sold products, imported products may contain the restricted chemicals or the chemical concentration may exceed the allowed levels. And, even if restricted chemicals and their concentrations would be in control for imported products, environmental load from product use can be transported around the world by winds and sea currents.

1.1.2 Release from the use of products

Releases of hazardous substances from the use of products can contribute significantly to the total chemical releases to the environment in a country. These releases are, however, not sufficiently well known due to lack of reliable data and methods to quantify them.

Products that contain hazardous chemicals can be labelled with hazard symbols. Examples of such products are impregnation agents, car care products, glues, washing agents, plant protection agents as well as flammable or explosive products. Even if the product is labelled with information that it contains hazardous substances, for instance explosives, the information does not detail the chemicals and their quantities in the product.

Environmentally hazardous substances can, however, exist in products without clear information of their presence. Examples of such products are furniture, electronics, kitchen and washing machinery (white products), textiles or toys.

1.2 Objectives

The objectives of this document are to collect existing information on releases to the environment from the use phase of products, and to identify substances for which a significant part of the releases originate from the use of products (Figure 2). Where information on methodologies to quantify the releases is available, this information is also provided in this document. The Compendium also provides information on activities by countries and different organisations in their efforts to identify, quantify and reduce releases to the environment from the use of products.

The document also aims at the identification of product groups and relevant chemical releases to the environment that are not yet covered by the regular inventories, and thus draws attention to less well-known sources. The outcome of the work can be used to give decision makers an indication of areas where further actions are needed to reduce releases, and to provide information to countries to support them in inclusion of releases from the use phase of end-products into their inventories and PRTRs.

Figure 2. Scope of the document

1.3 PRTR and non-point source releases

The public and private use of products falls under non-point source (diffuse) release sources that have traditionally not been included in PRTRs, as PRTRs are mainly limited to point sources (e.g. industrial facilities). However, many countries have started to include releases from non-point sources (or labelled as "diffuse sources") in their PRTRs. The obligation to do so is included also in the UN ECE PRTR Protocol and the European PRTR Regulation.

Part of non-point source releases from the public and private use of products are currently covered by regular inventory and reporting work in some OECD countries (Figure 3), while they are an inseparable part of the total releases during the life-cycle of products (Figure 4). The suitability of products, used and

produced in the manufacturing processes, for reuse and recycling, is a growing concern when the focus of integrated pollution prevention control is moving from reducing end-of-pipe releases to securing resource and environmental efficiency.

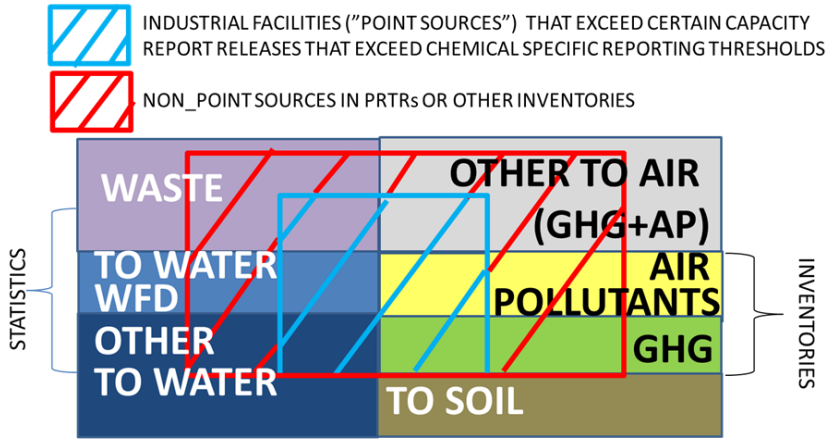

Figure 3. Sources currently included in PRTR registers or in other inventories

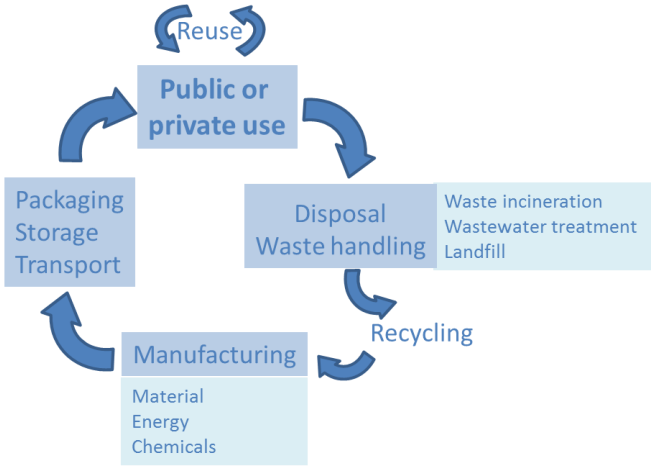

Figure 4. Product life-cycle

1.4 Scope of the document

The OECD Resource Compendium on Diffuse Sources [ENV/JM/MONO(2003)14] covers information on all non-point sources. This document is restricted to releases originating from the use phase of end-products that are not yet covered by existing data collection activities or reporting efforts. Also, the main focus has been on identification of product-related releases that have an impact on the environment, although information on health impacts have also been addressed as an indication of possible environmental releases.

In general, it can be concluded that there is more information available on possible health impacts of many products than on environmental impacts from the use of products. In many cases it can also be concluded that there are no or only negligible direct releases from the use of these products to the environment.

The release sources already covered by the PRTRs include mainly industrial activities such as energy production, industrial processes, storage and handling activities, mining, intensive life-stock farming and aquaculture, as well as waste and wastewater handling.

Information on releases from diffuse sources such as transport, residential combustion, and agriculture will also be included as part of the PRTRs by some countries, for instance in the European Union. These diffuse sources are already included in the reporting obligations under international air emission conventions, such as the United Nations Framework Convention on Climate Change and the UNECE Convention of Long-Range Transboundary Air Pollution.

Releases related to the use of products are to some extent already covered by the above- mentioned international conventions. Such releases are not addressed in detail in this document, i.e. non-methane volatile organic compounds (NMVOC) releases from the use of solvent containing products and particle releases from brake and tyre wear in road transportation.

This document neither covers sources that already are covered by other inventories, as presented below:

1) Covered by PRTRs:

- the use of fuel products and substances in energy production, transportation
- the use of products and substances in the manufacturing industries
- the use of pesticides and fertilizers in intensive life-stock farming
- product based releases from landfills, wastewater treatment and waste incineration

2) Covered by other inventories (e.g. the UNFCCC and UNECE CLRTAP):

- the use of fuel products and tyre and brake wear in transportation
- the use of solvent-containing products emitting non-methane volatile organic compounds (NMVOCs) to the air
- POP and heavy metal emissions from the use of products (under the existing reporting obligations of for instance the UNECE CLRTAP), but as the existing inventories of these chemicals currently not always cover the use of products, information on these releases, where available, is included in this document

3) Releases identified to only have health impacts but not impacts on the environment. Available information of these sources has been included while not going deeply into the release mechanisms and methodologies.

1.5 Methodology

1.5.1 Information sources

The document is mainly based on the contribution of Nordic research institutes and authorities, which provided information on their existing studies and inventories on releases from the use of products. Information on RETs for releases from the use phase of end-products was collected, where available.

In addition, a survey was carried out in OECD Member countries on existing information on releases from the use phase of end-products. Responses to this survey are included in this report. The results of the survey are presented in Chapters 2.

The information was completed by a literature survey, going through international conventions and legislation texts, as well as from recent international publications. It is likely that other relevant material not identified in this document exists, as a full search of scientific articles was not carried out and an increasing number of new information related to releases from products is published every month, and that should be taken into account when making conclusions of further work in this area.

1.5.2 Identification of products with relevant releases

1. The selection of product groups for this compendium covered the following criteria:

- Are releases of a substance/chemical from the use of the product likely?
- Does the product have widespread use, and is it high volume use?
- Can the releases from use of the product reach the environment in relevant volumes?

The criteria were developed to evaluate whether potential releases from the use of a product could be considerable.

The work also aimed to collect data on the geographical scope of the problem, where possible. However, during the work it became obvious that it was not possible to achieve this target due to the limited information sources. The case studies therefore present the information that was achievable for the study and also areas where it is not possible to draw further conclusions without additional information.

Based on available information, it can be concluded that, at the moment, knowledge of releases from the use of products is restricted to certain product groups and substances. Furthermore, there is not much knowledge of the actual contribution of releases from the use phase of end-products to the total releases of most substances/chemicals. However, there is a clear indication that a large part of the national total releases of certain substances may already originate in the use of products.

1.5.3 Criteria for evaluating methodologies

In the collection of information, the following evaluation criteria were used:

- methods need to be suitable for PRTR reporting,
- input data to calculations need to be accessible, and
- releases need to be estimated at a sufficient accuracy level.

To fulfil these criteria, several published calculation methods were compared and assessed and in some relevant cases experts from the industry were interviewed. For those product-chemical combinations where no calculation methods existed, the target was to establish a default RET. Some of the default RETs established are indeed rough, and will be improved when new information is collected.

The presentation of the RETs was planned to enable national agencies to adopt the calculations in their national release inventories. The assumptions and simplifications made in the methods are documented

together with the calculation method and references provided to the references used, to enable national adaptation of the methodologies, where possible.

1.6 Structure of the document

This document comprises of two parts; main body presents general information on releases from the use phase of products and annex includes information on techniques to quantify the emissions.

The main body is divided into nine chapters; between Chapter 2 and Chapter 4, the document provides information of activities by countries and different organisations in their efforts to identify, classify and quantify information and to restrict releases arising from the use of products. Chapter 5 presents information on likely releases generated during the use of products. Chapter 6 provides a general introduction to release patterns. Chapter 7 describes introduction to available RETs for releases from the use phase of end-products as well as a list of potential product groups for inclusion into national PRTRs. Chapter 8 presents issues to be taken into account when considering the inclusion of releases from products into PRTR registers as well as recommendations on product groups to be included. Chapter 9 addresses conclusion and recommendations.

The annex presents information on releases from the public and private use phase of some selected products. RETs are presented for 10 products and chemicals. Product group and chemical specific RET information is provided in the eleven case studies in Volume 2.

2 OVERVIEW OF CURRENT KNOWLEDGE ON INVENTORIES FOR RELEASES FROM PRODUCTS

2.1 Current knowledge of releases from the use of products

For those chemicals that have been inventoried, the release trends from facilities that report to PRTRs (point sources) in the Nordic countries have mainly been decreasing over the past decades. Along with this positive development, the contribution of non-point sources to total releases has grown. The growth in the volume of products and the increasing number of chemicals in them contributes to this trend. Chemicals are added to products during the production and finishing of the items as well as during the distribution and use phases. The chemicals interact, often also with the product material, resulting in new chemical combinations.

The release mechanisms of chemicals from the products to the environment vary from break-down to transformation of product material and are affected for instance by product use patterns and the product – chemical combination properties.

At the moment, health effects of chemicals released from products are better known than the quantities and effects of chemicals released to the environment. Many hazardous substances used in products have been substituted with other chemicals that not always have proved to be safer. Reduction of chemical releases can be achieved through international conventions restricting the releases, through national legislation as well as by taking voluntary initiatives and setting consumer demands on safe chemical content of products. However, the national restrictions vary between countries.

A wide range of products are identified to have possible releases of hazardous chemicals to the environment. However, information on the concentration of chemicals in products is not always available, and even less information is available on possible releases and release rates. Even the companies selling the products do not always have knowledge of their chemical content or the quantity of the chemicals. As examples of direct releases to the environment from the use of products, please see Volume 2 of this document.

To give an overview of the variety of the topic, some examples of current knowledge of direct chemical releases from the use of some products are presented in Table 1.

The table provides examples of some products and chemicals that may be released from them during use, an indication of environmental media where the releases may end up (atmosphere, surface water, soil) as well as of an existing RETs. Explanation of colours and acronyms in the columns on the right side of the table is provided below.

- The destinations where the releases are assumed to end up are indicated by colours.
- Some chemicals fall under official reporting/restrictions by international conventions, these are given by acronyms: if the chemical name is underlined, there is a reporting obligation for this chemical. If the chemical acronym is presented in italics, there is no (official) calculation method to estimate these releases.

Table 1. Examples of some chemical releases from the use of products:

EXAMPLES OF PRODUCTS		EXAMPLES OF CHEMICALS	Codes on page 11
Building and construction	Bitumen roofing	*PCB*	L, P (+ indoor)
	Concrete	*PCB*	L, P
	Pipes (copper and PVC pipes)	*Cu, Pb, Hg*	W
	"Do-it-yourself-products"	*NMVOC, SCCPs*	C, L, P
	Flooring and carpets PVC flooring	*PFOA, PFOS, musk xylenes phthalates (DEHP), Pb, As*	(+ indoor)
	Isolation material XPS in building blocks, moisture proof elements, outdoor isolation	*BFRs (HBCDD), HCHO*	(+ indoor)
	Isolation material EPS (expanded polystyrene)in walls and roofs	*BFRs (HBCDD)*	(+ indoor)
	Paint, varnish	*As, BPA, Pb, Hg, phthalates (DEHP), Cr, NPs, Ops, PFOS/PFOA, NMVOC, HCHO, isocyanates, isothiazolines, PCB*	C, L, N ,P, O (+indoor)
	Roofing, leaded sheets, window frames, flashings, facades, wall claddings	*Pb, DEHP, Cu, Cr, Ni*	W
	Sealants and caulk	*PCB, Pb*	L, P
	Wall papers	*BFRs, phthalates, Pb, As, CPs*	(+ indoor)
	Windows and outdoors	*BPA, Pb, BFRs, phthalates, CP, PFOS/PFOA, NPs, Ops*	(+ indoor)
	Windows and outdoors, isolated	*PCB* (windows), *clorfluorcarbons, hydrochlorfluorcarbons* (outdoors)	C, L, P (+ indoor)
	Treated wood	*CCA (Cu, Cr, As), PAH, TBT, TFT, HCBs, PCBs, PCNs, PFOA, HCBD*	L, P, W
Cars, boats, trains, machinery	Car and boat care products	*PFOS/PFOA, NMVOC, musk xylene, siloxanes (D5), cationic surfactants (DODMAC), tensides (DTDMAC, DSDMAC, DHTMAC), NPs*	C, L, N, P, W
	Car tyres and brakes and wheel balance weighs	*As, Cd, Cr, Cu, Pb, Hg, Zn, particles, phthalates (DEHP), alkylphenols, PAH, BBP*	L, P
	Boat keels	*Pb*	W
	Oil losses on roads	*Pb*	L, P, W
	Wear of current contact on electric trains Collector shoes (train and tram rails)	*Cu* *Pb*	L, P, W
	Hydraulic and heat transfer fluids, lubricants	*PCBs, Pb, NMVOC*	C, L, P, W

Kitchen equipment	Baby bottles, tins	*BPA*	O, health
	Imported plastic spatulas and scoops	*aromatic amines (PAA)*	O, health (+indoor)
	Glasses and glazes Table wear	*Cd, Pb*	O, health
Cosmetics, pharmaceuticals	Deodorants	*musk xylene, siloxanes (D5), triclosan,* NMVOC	C, L, N, P (+indoor)
	Dental amalgam Toothpaste	*Hg* *triclosan*	
	Freshen-op-towels	*musk xylene, siloxanes (D5) NMVOC*	C, L, N, P
	Hair care products, dyes	*p-phenylenediamine, toluene-2.5-diamine,* NMVOC	C, L,N,P (+allergen)
	Lotions	*musk xylene, siloxanes (D5)* NMVOC	C, L, N, P
	Nail polish and hair sprays	toluene (NMVOC), *phthalates*	C,L,N, P (+irritation)
	Pharmaceuticals	*Hg, NPs*	
	Soap and shampoo	*musk xylene, triclosan, siloxanes (D5),* NMVOC, *NPs, PFOS*	C, L, N, P
	Sun tan cream/ lotion	*musk xylene, siloxanes (D5)* NMVOC, *EHMC, MBC, OC, BMDBM, BP3, phthalates, parabens*	C, L, N, P
	Toothpaste	*triclosan*	
Electronics and electronical equipment	Accumulators and batteries	*Cd, Ni, Pb*	
	Capacitors and transformers	PCB	L, P
	Cables and wires	*Cu, Pb, PCBs, phthalates, DEHP, SCCP*	W
	Domestic appliances (refrigerators, freezer, washing machines etc.)	old products: *Pb, Hg, Cr, BFRs (PBB, PBDE)* new products: *chloroparafins, phthalates, BFRs (PBB, PBDE), Ag,* NH_3, *PFC*	L, P (+indoor)
	Instruments for measuring Switches and relays Solders, circuit boards	*Hg* *Hg* *BRFs, Pb*	L, P
	IT equipment, TV, radio, stereo equipment	old products: *Pb, Hg. Cr, BFRs (PBB, PBDE)* new products: *chloroparafins, phthalates, BFRs (PBB, PBDE), PCBs*	L, P (+indoor)
	LED lamps	*As, Hg*	L, P
	LCD flat screens	*Hg*	L, P
Furnishing	Furniture and furnishing material, carpets	*As, Cr, Pb, Hg, NMVOC, BFRs, phthalates, Cr, NPs, Ops, HCHO, amines, HBCD, PBDEs, PFCs, CP, organotins, pesticides, DMF*	C,L,N,P (+indoor, allergen)

Office, Other products	Ammunition Tracer bullets (military)	As, Pb HCBs	W
	Curtain weights	*Pb*	
	Fire extinguishers	*PFAS/PFOS*	
	Firework	As, Cd, Cr, Cu, Pb, particles	L. P
	Fishing gear and weighs	*Cu, Pb*	
	Glue	NMVOC, *BPA, phthalates (DEHP), NPs, Ops, HCHO, isocyanates*	C,L,N,P,O (+indoor)
	Pens, pencils, drawing ink	*As, Pb, Cr*	health
	Pesticides	Pb, HCB, *HCBDs*	L, P, W
	Photograph	*Ag, PFOS*	
	Radiation shielding	*Pb*	heath (+indoor)
	Tobacco, cigars	*As, Cd, Cr, Cu, Pb, Hg, NH_3,* PAH-4, PCDD/F particles	C,L,N,P (+indoor, health)
	Toys, low-cost jewellery	*NMVOC, phthalates, Pb, Cd, Sn*	health (+indoor)
Textile, leather, plastics	Textiles: Impregnation agents, waterproof treatment, antibacterial treatment	*PFOA, BFRs, SCCPs, phthalates, NPs, Ag*	health (+indoor)
	Leather	*PFOS/PFOA, Cr, DMF*	W
	Colours and treatment agents	*Pb, Cr*	W
	Decoration of plastic or leather imitation	*chloroparafins, phthalates (DEHP), BPA, Pb*	O, irritating
	Imported textiles: remaining from washing and colouring products	*NPs*	W
	Pesticides Antibacterial agents	*DMF* *Ag*	W
	Mattress	*As, Pb, phthalates, Cr, NPs, Ops*	(+indoor)
	Shoes	particles, *Cr, DEHP*	L, P
Cleaning	Laundry detergents, dry and wet cleaning agents, floor polish and waxes, soap	*PFOA/PFOS, musk xylene, siloxanes (D5), cationic tensides*, NMVOC, *NPs, phthalates, LAS, NH_3*	C,L,N,P (+indoor, irritating)

NOTE that in addition to the example products listed in this table there can be other chemicals in the products that are not identified in this table of examples. The examples in the table include some chemicals that are not on the E-PRTR list of chemicals.

Direct to Air	Direct to Water	Direct to Soil	Channelled/abated air emissions	Through wastewater treatment plant	Releases at landfill
C = UNFCCC, United Nations Framework Convention for Climate Change L = CLRTAP, UNECE Convention on Long-Range Transboundary Air Pollution N = NECD, EU National Emission Ceilings Directive O = Other international convention (e.g. EU Directive) P = PRTR, Aarhus Convention, Protocol on Pollutant Release and Transfer Registers U = UNEP POP Convention W = WDF EU Water Framework Directive					

2.2 Releases in waste streams

Indirect chemical releases to the environment from the use of products exist through waste streams. Studies carried out in the recent years indicate that the use of products may be a major source of chemical releases, especially for heavy metals and POPs (Jonsson et al, 2008 and Sörme et al, 2001).

In the Nordic countries releases from publicly or privately used products are in many cases captured by organized waste management systems such as landfills, waste incineration plants or wastewater treatment plants. Examples of releases from products that may be collected by mixed water sewers (storm and municipal sewerage) and thus be led to wastewater treatment plants, are buildings and car care products. However, while these releases would be captured by treatment facilities, it does not guarantee that the releases are treated. For instance in Stockholm the waste water treatment plant Henriksdahl directs 53 % of the storm water to treatment while 47% remains untreated and is directed immediately to the environment.

In Sweden, work has been carried out to identify origin of heavy metals in waste that is combusted for energy production purposes. Heavy metals accumulate in sludge and ashes, which restricts the possibilities to recycle these. As no actual sources for heavy metals have been identified, it is believed that the heavy metals originate from use of different products. It has also turned to be challenging to show which products are those where the heavy metal content should be restricted (Avfall Sverige, SMED 2012).

The presence of organic substance concentrations, for instance DEHP, DIDP, DINP, nonylfenol, PAH, PCB, PentaBDE, DekaBDE, PFOS, TBT and triclosan, in municipal sludge suggest that their origin may be consumer products, as most chemicals that are used in society are found in wastewater and storm water to wastewater treatment plants. However, the WWTPs are not designed to destruct these chemicals, and thus these chemicals mainly end up in waste water treatment sludge. Today, chemical thresholds set for recycling of sludge e.g. in agricultural purposes are generally exceeded (Stockholms stad, 2013).

As an example of releases from waste streams, please see calculations for heavy metals and NMVOC compounds from plastic bags in Volume 2 of this Document.

2.3 Indoor emissions

Indoor emissions from the use of products are common, and are in many cases treated as health concerns. Emissions from indoor environment may be transported to the atmosphere for example through ventilation systems.

As an example of this type of releases, information on DEHP emissions from PVC flooring are provided in Volume 2.

2.4 Releases from "old" product sources – stocks and inflows

Studies in the Nordic countries have shown that hazardous substances that have been restricted for the longest period can still leach out from old stock of material or products/articles. Examples of these are old concrete constructions, contaminated land at old industrial sites, sediments in the sea and lakes, arsenic from impregnated wood as well as products in old landfills. (SSB 2012; CCOHS 2013)

The accumulated amount of chemicals in all products in the society is often is referred to as "the stock". Stocks of chemicals can build up out of all kinds of products, material and articles. From these stocks, hazardous chemicals such as heavy metals and POPs can be released during long periods of time, e.g. leakage may occur from buildings that were constructed decades ago.

In Sweden, substance flow analyses have been made to capture information of the heavy metal and persistent organic pollutant trends in Stockholm City area. A substance flow analysis presents information on the flow of a substance in a specific area during a specified time as well as the accumulated stock in the society. Depending on the residence time of the substance within the system, the stock may be more or less important. For substances in products with a short life length (e.g. herbicides) the stock is less relevant than for long-lived products such as construction material, from which the stock may cause extensive releases for a long time. (Jonsson et al. 2008). A long life expectancy, on the other hand, indicates a slower flow through the society and a greater challenge for recycling (Sörme et al., 2001).

Figure 8 illustrates the development of heavy metal flows and stocks in Stockholm from 1995 to 2002/2003 and shows that the stocks have decreased for cadmium, lead and mercury. During the studied period the stocks decreased with 30% for cadmium and 25% for mercury. The inflow decreased significantly for cadmium (75%) and mercury (93%), whereas the inflow of lead grew due to increased use in batteries. Lead emissions are decreasing, and although cadmium and mercury emissions are better quantified in 2002/2003 the amounts still are in the same range as in 1995. It can be thus concluded that although the inflow decreases, it takes longer time for diffuse releases to decrease due to the large amount built up as a stock in the society.

Another example is PCB, which was banned in the Nordic countries in the 1970s. Since then, PCB concentrations in the environment have decreased. However, there are still PCBs in biota, e.g. in fish, due to slow chemical removal rates (Evira 2013).

As examples of this type of emissions, information on PAH releases from bitumen roofing products and PCBs from sealants in building and construction are provided in Volume 2 of the Document, Part A, chapters 1 and 7, respectively.

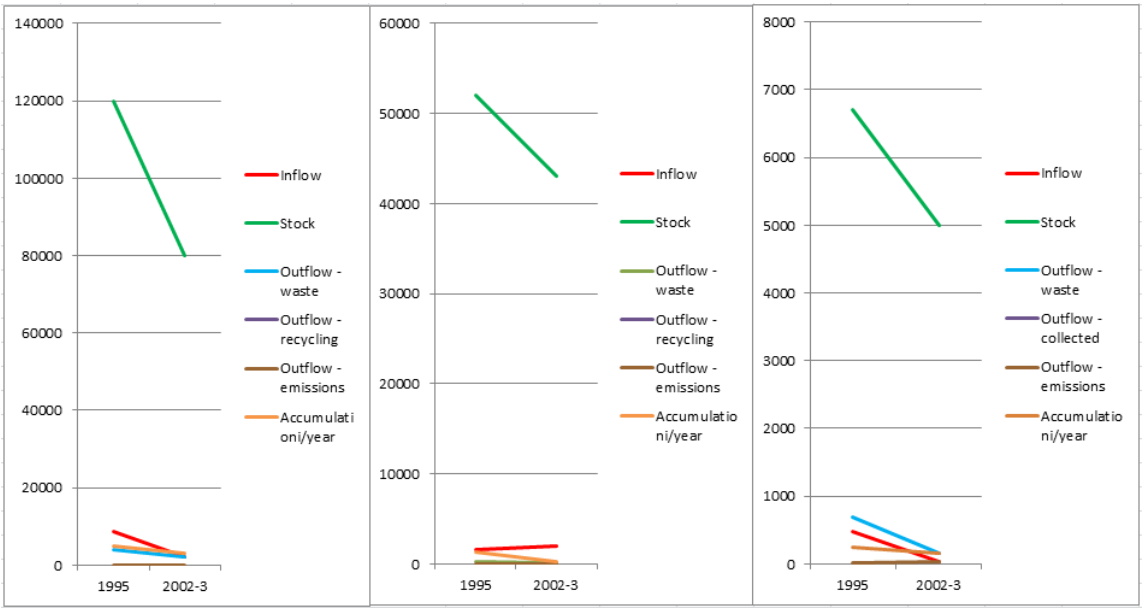

Figure 5. Approximated stocks and flows of cadmium, lead and mercury in Stockholm city in 1995 and 2005

Studies carried out in Stockholm showed that the amount of copper in water to WWTPs originates mainly from corrosion of pipes, water-heaters, and heat exchangers in the tap systems and copper roofs (Sörme and Lagerkvist 2002). This result confirms that diffuse emissions from products can contribute effluents to WWTPs.

2.5 Quantifying releases from products

There exist currently few methods to quantify the releases from the use of products, and for those RETs (Release Estimation Techniques) that exist, the uncertainties may be high. Also, more precise information is needed about the release mechanisms and the affecting factors. However, there are already some information systems, such as product registers, which contain some relevant data to enable qualification of releases in certain cases.

Based on information collected during the study, it is also likely that in many cases the product groups and relevant releases may be country-specific due to the use of different product groups or product types, which have different chemical contents, or due to differences in the use and disposal practices of products as well as due to different national restrictions.

Thus, there is sufficient information available regarding releases from the use of certain product groups to enable inclusion of some chemical releases to the national PRTRs, if countries so wish.

- According to material reviewed in this study, the following end-product groups have been identified to have environmentally relevant chemical releases during their use-phase. Please note, that the list below is not exclusive/exhaustive due to the fact that in general only little information is available on the chemical contents of products and even less on concentrations released from the use phase of these products:

- Building and construction products

- Electrical and electronic products

- Furniture
- Nanoproducts
- Packages and plastic bags
- Pesticides
- Pharmaceuticals, personal care and cleaning products
- Textile and leather products
- Toys and low-cost jewellery

In addition to the product groups listed above, two chemical specific case studies, one on lead and the other on nonylphenols, were carried out in the Nordic projects, to identify product groups from which lead and nonyphenol releases to the environment can be likely during their use-phase. Lead and nonylphenol were selected as examples of such chemicals, for which there exist information regarding their releases, and which releases not always are included in the regular inventories maintained by countries. For instance, the reported trends of releases of lead to the air have been generally declining since the ban on leaded gasoline in the beginning of the 1990s. However, these trends seldom include releases of lead from the use phase of other not banned products, and might therefore not in all cases reflect the true trends. For nonylphenols, it has been discovered only recently that the releases from textiles to water may be significant and that the trend may also be increasing.

Examples of releases from the use of products are presented in Table 2 below.

Table 2. Examples of releases from the use phase of end-products

Chemical oriented case studies	
Lead	Releases from ammunition (shots and bullets), fishing equipment (weights), lead containing paint, and lead sheets used in roofing and flashings. The use of lead in products has to some extent been restricted, but there are still lead containing products in use.
Nonylphenols & -ethoxylates	In the Nordic countries, the major releases originate in textiles and cleaning agents. Other sources include paints, adhesives, pesticides and veterinary medical products.
Product oriented case studies	
Building & construction products	Releases include heavy metals (e.g. lead in lead sheets and paint), wood impregnation agents (e.g. CCA) and different additives (e.g. plasticizers) in materials. The use of PVC plastics in construction and building products has increased. Though the use and thus also releases of certain hazardous substances have ceased, there may be large amounts released due to the previous extensive use (e.g. PCBs in sealants and caulk).
Electronic and electrical equipment	Releases include flame retardants used in the plastic casing and printed circuit boards, heavy metals (Pb, Hg) from solders and different components. Where such equipment is used, elevated concentrations of flame retardants have been measured in indoor air and dust. Discarded electronic equipments often end up for disassembly or destruction in developing countries and the metals recovered may be used e.g. to make low-cost jewellery. The use volume if these products are increasing.
Furniture	Releases of flame retardant (e.g. from mattresses and the foam in furniture), surface coating (e.g. dirt repellent carpets) and anti-mould agents (e.g. in couches).
Nanoproducts	No information of releases from the use of nanomaterial in products has been identified. However, nanomaterial are widely used in different every day products, and new nanoproducts are entering the market.
Packages and plastic bags	Releases include e.g. phthalates and heavy metals from PVC plastics, perfluorinated compounds used from oil resistant food packaging.
Pesticide	Pesticide releases from the use of crop protection and wood protection agents, pipes, paints and carpets.

Pharmaceuticals and personal care products	Relevant releases may occur in cases where wastewater discharges are not lead through wastewater treatment plants to the receiving waterbodies: e.g. antibiotics, hormones, disinfectants and detergents.
Textile and leather products	Releases include nonylphenols, heavy metals and perfluorinated compounds.
Toys and low cost jewellery	More information on health effects is available than on releases to the environment. Releases to the environment may occur if products left in direct contact with the environment. Low cost jewellery: releases of lead, cadmium and nickel. Plastic toys: heavy metals, additives (e.g. phthalates).

Information on RETs has been presented where documented methodologies were found. In addition, during the Nordic projects on releases from the use of products, default methodologies were derived for nonylphenol and nonylphenol ethoxylate and for lead releases from certain product groups.

2.6 Overview of existing inventories on releases from products

Some countries already carry out annual inventories on releases from products and there is an increasing number of research projects and international work to explore these releases. Current information on releases from the use phase of end-products can be roughly divided into five categories according to the type of information sources available during the study.

1) Information on quantified releases with documented RETs used for mandatory regular reporting to international conventions (Chapter 2, Table 2).

- This information includes air emission estimates from certain product groups for certain substances already included in the regular inventory work in most of the OECD Member countries. The RETs used for quantification of releases are published in the guidebooks for the conventions under which the inventories are carried out (e.g. UNECE CLRTAP). The chemicals and product groups covered by the inventories are non-methane volatile organic compounds (NMVOCs) from the use of solvents, mercury from dental amalgam and heavy metals from tyre and brake wear.

2) Information on quantified releases with documented national RETs in inventories carried out by certain countries on products and chemicals relevant for that country (Chapter 2, Table 3 and Annex 2).

- This information includes actual quantified release estimates to air, water and land. Documentation of the RETs is either published or non-published. These inventories exist for instance in Japan, Korea, the Netherlands and Norway.

3) Information on quantified releases and related information on RETs, inventories carried out by industry associations or research groups (Chapter 5).

- This information includes calculated actual release estimates to air, water and land by the industry branch, product groups or by regions. Documentation of the RETs is usually published. For example, the International Lead Association (ILA) has carried out inventories on lead and nickel releases and there are several research projects in Denmark, Norway and Sweden. A comprehensive study on the releases of DEHP covering the whole life-cycle is carried out in the EU Risk Assessment Programme (Kemi, 2001).

4) Information on quantified releases and related information on RETs by different groups working with chemicals risk assessment (Annex 4).

- This information includes often worst-case release estimates to air, water and land. Documentation of the RETs is published. For example, the OECD Task Force on Exposure Assessment has prepared several emission scenario documents for the total life cycle of a number of products. However, in these estimates, it is not always possible to identify the part of releases that is related to the use phase of products.

5) Indication on the evidence or likelihood of releases from the use phase of a product: this type of information is available from the literature or from non-governmental organisations, but often carries no remarks on the magnitude of releases to the environment, nor information on available RETs (Chapter 5).

Table 3. Examples of chemicals from certain product groups that are already included in regular inventory work for emissions into the air

Product group	As	Cd	Cr	Cu	HCB	HCH	Hg	Ni	NMVOC [2)]	NH3	PAH-4	Pb	PCDD/F	PFC	PM	Zn
Releases from accumulator and battery (waste)		x						x				x				
Brake and tyre wear (road transport)	x	x	x	x			x				x	x			x	x
Building products, DIY(do-it-yourself)									x							
Car care products (car manufacturing)									x							
Chlorinated chemicals use (industry)						x										
Cooling agents in household use														x		
Electronic products (use)							x									
Firework	x	x	x	x								x			x	
Household products									x							
Fertilizer/pesticide use (agriculture)					x	x				x					x	
Surface treatment (in the industry)									x			x				
Paint application (industry, *domestic use)*									x							
Pharmaceuticals and personal care products									x							
Tobacco smoking	x	x	x	x			x				x	x	x		x	
Treatment/impregnation of wood (industry)									x							

1. UNECE CLRTAP (F-gases, NMVOC, NH3, particles, heavy metals, POPs), UNFCCC (F-gases, NMVOC) and EU NECD (NMVOC, NH3), methodology according to the EMEP Corinair Inventory Guidebook (EEA, 2009)

2. Product groups printed in *italics* fall under the scope of this project. If this data already exists in the national inventory, it can be incorporated in the PRTRs (product groups 2, 6, 7, 8, 9, 12, 13 and 14) – NOTE that the existing information mainly covers only NMVOC releases but that there are also other likely releases (e.g. heavy metals and POPs) from the same product groups not yet included in any inventory.

3. Product groups not printed in italics are also indicated to have releases during their use but these releases are included under other sources (indicated in the brackets) in the reporting of inventories, than under the use of products (product groups numbers 1, 2, 4, 5, 9, 10, 11 and 15).

Table 4. Examples of national inventories of releases from products in certain countries (I = inventory exists) . Note that this list is not exclusive.

Product group	As	BFR	Cationic tensides musk compounds	Cd	Cr	Cu	DDT	DeBDE	DEHP	HBCD	HCH	Hg	MCCP	NP NPE	Octa-BDE	NH3	PAH	Pb	PeCB	PFAS/ PFOS	SCCP/	TBT TFT
Ammunition	I					I								I				I				
Asphalt																	I					
Batteries, accumulators	I			I														I				
Brake blocks						I												I				
Building and construction		I											I								I	
Cables																					I	
Cleaning agents			I											I		I						
Cosmetics			I																			
Electronic products		I					I				I	I										
Fertilizer use (agriculture)				I		I						I				I						
Fire extinguishers																			I	I		
Fireworks	I				I	I												I				
Flame retardants								I		I					I				I			
Fishing gear and weighs						I												I				
Instruments for measuring												I										
Keels of sailboats																		I				
Lead sheets																		I				
Light sources												I										
Pesticides						I								I								
Pipes						I																
PVC-plastics									I													
Steel products					I																	
Textiles																				I		
Surface treated products					I	I			I				I	I			I	I			I	I
Tooth filling												I										
Treated wood	I			I	I	I											I					I
Vehicle parts				I																		

2.7 Inventories, programmes and projects on releases from products

2.7.1 Regular inventory work

According to the responses to the survey made to OECD countries (Table 3), four OECD member countries indicated to currently have information on releases from the use of products in their national PRTR or other inventory and five more countries were planning to include this information. Three countries had plans to include new products and four countries new chemicals in their systems. Detailed documentation of the survey and the responses is provided in Annex 3.

The four countries carrying out regular inventories on releases from products, e.g. Japan, Korea, the Netherlands and Norway, have partly different product groups included in their inventories. The Japanese inventory on product related releases includes the following product groups: pesticides, paints and adhesives, medical products, cleaning agents and cosmetics, and foam blowing agents. The Korean inventory includes batteries, several household products, and light sources. The Netherlands' inventory includes wood protection agents, fireworks, shooting clays, lead slabs, fishing tackle, and pesticides. The Norwegian inventory includes wood impregnation agents, paints, pipes, pesticides, ammunition, tooth fillings, lighting sources, granulated rubber, textile impregnation agents, cleaning agents, electrical and electronic products, and construction products. Detailed information on the content of these inventories is provided in Annex 2.

In addition, all countries that are parties either to the UNFCCC or UNECE CLRTAP have information of at least air emissions of NMVOC compounds from the use of solvents.

Table 5. Inventories carried out by countries on releases from the use of products (other than already included in the existing inventories)

PRODUCT INFORMATION IN PRTRs OR OTHER INVENTORIES					PLANNING TO INCLUDE			
Country	Currently included		Planning to include		New products		New chemicals	
	YES	NO	YES	NO	YES	NO	YES	NO
Belgium		x		x		x		x
Chile		x	x		x		x	
Czech Republic		x		x				
Denmark		x						
Finland		x	x		x		x	
Japan	x					x		x
Korea	x							
The Netherlands	x				x		x	
Norway	x		x			x		x
Sweden		x	x			x	x	
Turkey		x	x			x		x
Switzerland		x		x				
USA		x		x		x		x
UK		x		x				

According to replies to the questionnaire sent to OECD countries four countries (Japan, Korea, the Netherlands and Norway) currently carry out inventories on product related releases of lead and five more

countries collect some information on these releases, while three countries had product related legal restrictions on lead (Table 5).

Only Norway[1] carries out inventories on product related releases of nonylphenols and also Sweden had some information on these releases. Seven countries had product related legal restrictions on nonylphenols (Table 6).

More information on legal restrictions for product related releases in countries is presented in Chapter 3.2.

Table 6. Information on regular or study-based national inventories on releases from lead containing products (industrial sources excluded), estimated releases and their contribution to total lead releases in the country

Product containing lead	Country	Lead release (kg)	Contribution	Year	Remarks (the information below was provided by countries as reply to the survey)
Alloys with lead	Sweden	NA	NA	2005	Activity data 800 t
Ammunition	Netherlands	5400	NA	2005	Emission factor 3.93 g/bullet before 1993; 6.86 g/bullet after 1993
	Norway	201000 to soil	NA	2006	Lead content 60%
	Sweden	NA	NA	2005	Activity data 580 t
	USA	NA	NA		AP-42 (federal facilities with firing ranges)
Boat keels	Sweden	NA	NA	2005	Activity data 1000-2000 t
Brake wear	Netherlands	2400 to air, 1300 to water, 1400 to soil	7% air, 1% water and soil	2006	
Corrosion protection paints	Norway	1360 to soil	NA	2006	Emission factor 10% of use
Electronics	Sweden	NA	NA	2005	Activity data 500 t
Fishing gear	Netherlands	30000	NA	2005	Emission factor 1.8 g/inhabitant
	Norway	47500 to water	NA	2006	Water 25%,waste 50% [3)]
	Sweden	NA	NA	2005	Activity data 400t
Wear of current contact on electrical trains	Netherlands	60 to water	NA	2005	
Glass, crystal, cut glass	Sweden	NA	NA	2005	Activity data 70 t
Lead acid batteries	Korea	45871545.9 to waste	NA	2005	
	Norway	0	NA	2006	Emission factor 60% [3)]
	Sweden	NA	NA	2005	Activity data 2000 t
	USA	NA	NA		AP-42 (only facilities under TRI)
Lead sheet (roofing)	Belgium	7305	NA	2005	Emission factors for 8 building types, distribution factors for environmental compartments
	Netherlands	21000	NA	2005	Emission factor 5 g/m^2 for house roofing, 0.124 g/m^2 for industrial roofing
	Sweden	0	NA	2005	Activity data 0 t
	Switzerland		NA		
Lead pipes	Belgium	806	NA	2005	
Oil losses on roads	Netherlands	19 to water, 1 to soil	Minor	2005	
Paints	Japan	83302	NA	2006	Emission factor 2% of lead in pigment; 18% for traffic paint

[1] Norway carries out two regular inventories on releases from products: the inventory by Norwegian Environment Agency (SFT 2009) targets hazardous substances from all sources while the inventory by Statistics Norway (Kittelsen et al. 2008) generates indicators.

	Norway	corrosion of paint	NA	2006	Emission factor 10% [3)]
	Sweden	NA	NA	2005	Activity data 30 t
Pavement wear	Netherlands	110 to water	0.1%	2005	
Plastics	Norway	NA	NA	2006	
	Sweden	NA	NA	2005	Activity data 20 t
Sand from sand blasting	Norway	1000 to soil	NA	2006	
Tyre wear and brake wear	All parties to CLRTAP	70 to air,1300 to water 1400 to soil	0.1-0.5%	2005-2006	
Wheel balance weights	Sweden	NA	NA	2005	Activity data 900 t
Wood impregnation	Norway	NA	NA	1995-2006	
X-ray protection	Sweden	NA	NA	2005	Activity data 70 t

NA = information not available, activity data = statistical or other data used in quantification of the releases.

Table 7. National inventories and studies on releases from nonylphenols containing products (industrial sources excluded), estimated releases in the country

Product containing NPs	Country	NP release (kg)	Year	Remarks
Adhesives	Sweden	NA	2006	Activity data 1.46 tonnes (NP/NPE)
Cleaning agents	Norway	2700 to water	2005	Emission factor 90%
	Sweden	NA	2006	Activity data 3.34 tonnes (NPE)
Granulated rubber (synthetic grass fields)	Norway	9 to water	2005	
Motor and other oil	Sweden		2006	Activity data 1.77 t (NPE)
Paints	Sweden	NA	2006	Activity data 13.24 t of NP/NPE + as bonding agent in paints and glue 8.72 t (NP/NPE)
Pesticides	Sweden	NA	2006	Activity data 1.81 tonnes NPE
Polishers	Sweden	NA	2006	Activity data 1.86 tonnes (NPE)

2.7.2 Research programmes and projects on releases from products

Regular national inventories on releases from products are carried out by Norway[2], Japan, the Netherlands and Korea (Annex 2). In addition, information on releases from products is included in numerous research projects, models or other programmes that are carried out in many OECD countries. Some examples of this work are provided below.

In Belgium, an environmental input-output model is underway to map the most polluting production and consumer chains. In addition to the environmental effect of industrial processes, the model also includes environmental impacts from the use-phase of products.

In Sweden, a governmental research programme, ChEmiTecs[3], is running from 2007 to 2012 with the goal to improve the understanding of releases of organic substances from articles and to clarify and determine the magnitude of this problem. The work is carried out in collaboration with authorities, producers and downstream users by the Swedish Environmental Protection Agency, Swedish Environmental Research Institute, Stockholm University, Royal Institute of Technology and Umeå University. The programme focuses on selection of problematic chemicals, articles and uses patterns and also produces release estimates for these articles. Technical and social aspects, which contribute to the identified problems, are included as well as analyses of voluntary and legislative reduction strategies. Work carried out in the

[2] Product related information is available at http://www.miljostatus.no/Tema/Kjemikalier/Produkter/#

[3] More information of the Swedish ChEmiTecs programme is available from www.chemitecs.se

Chemical (REACH) and Product Policies (IPP, SCP), environmental chemistry, toxicology and engineering, analysis in the nature and results from risk assessment work are taken into account in the work.

In Sweden, several studies on releases from selected product groups have also been carried out at the Swedish Chemicals Agency (KemI), starting from the pioneer project in 1994-1999 regarding the inflow, stock and emissions of heavy metals from products during their use.

In Denmark, several studies have been carried out on the chemical content of various consumer products such as, toys and other children's products, low-cost jewellery, hobby products, cosmetics, pharmaceuticals, nanoproducts. These include risk assessments on the effects of various substances used in products on people and the environment. For instance, the Danish studies on indoor contaminants clearly show that product related releases occur as product use is the only possible source of certain chemical concentrations in house dust.

The Nordic Council of Ministers (NCM)[4] provided resources for compilation of information related to RETs for releases from the use of products. The results of the project are presented in this document. The project funded by the NCM also included quantification of releases from the use of products in the Nordic countries (Annex 6).

In Japan, the current studies are related to substances in electrical and electronic products, hazardous chemicals in plastic products as well as to brominated flame retardants and POP compounds from household products. (UNEP 2009c)

Work to identify and estimate health impacts and releases to the environment from the use of products is under way in some African countries, China, India, Peru and Thailand where experts have estimated certain releases from selected articles for their region (UNEP 2009c). For instance, product related effects on human health and the environment in African countries have been studied related to the trade of products containing lead, cadmium and mercury. In India, releases from toys, jewellery, paints and electronic products are studied, while risk management studies on PFOS compounds are carried out in China.

2.7.3 Comparability of release data

When comparing information on release data presented in the different inventories, studies or research programmes on releases from the use of products, it can be seen that the results may differ significantly. In many cases only the results of calculations are presented without any documentation or justification of the methodology. Neither is it clearly stated how the concept "product use" is understood: whether the release estimates cover the whole life-cycle of the product or which parts of the life cycle are included, or if the data represents the use phase of products (e.g. after the product has left manufacturing and before it is taken into waste management[5]). Thus it is difficult to conclude whether there are actual differences in the

[4] Nordic Council of Ministers http://www.norden.org/en

[5] For instance, releases to all environmental compartments from the manufacturing of batteries till the disposal and waste treatment can be included in one estimate, while the other estimate may give air emissions from incineration of batteries in household waste or releases to soil from the abandonment of batteries in the nature. Releases covered by the current Nordic study on releases from the use of products would cover only releases from the use of batteries, such as from possible leakages due to unintentional breakages of batteries or (if such would occur) evaporative releases during the use.

data presented, and if the differences represent the real differences, such as for instance, different use practices or differences in the chemical contents of a given product.

Reasons that may explain the differences in the results of the different inventories can thus be found in;

1. Completeness of the inventories: Product species or product groups included in or excluded from the different inventories are not defined or explicitly listed in the documentation of the inventory, therefore it is not possible to conclude if the products included in the different inventories have been the same.

2. Differences in the methodologies: It cannot be concluded how well the emission factor used in the calculations represents the actual emission rates due to lack of documentation. The values used as release rates in the different inventories can be different even for similar products, and the uncertainties of these emission rates may be high. However, the estimates of the different emission rates can also present actual differences in the chemical content or structure of a product or the tendency to releases.

3. Differences in how well the calculations represent the actual use of the given product: Statistical data should be available in a correct form to match the release rate used as an emission factor. It may be difficult or even impossible to retrieve representative activity data for calculation of product use related releases as this type of data is often not collected by statistical authorities. In many cases expert estimates are used instead of calculations based on statistical data, and the related uncertainties may be high.

3 WORK AND TOOLS TO RESTRICT RELEASES FROM PRODUCTS

3.1 International and regional work

International organisations such as UNEP, WHO and UNECE (Table 6) carry out work related to the management of chemicals used in products. Work carried out at more regional level is presented in Table 8.

Table 8. Work by international organisations on releases from end products

Organisation	Policy framework/ Convention/ Protocol	Target group	Aim	Actions
UNEP/ WHO	SAICM (ICCM)	Chemicals	Sound management of chemicals by 2020	
WHO	IFCS	Chemicals	Develop and promote strategies on sustainable chemicals management	Implementation of SAICM
UNEP	Stockholm Convention	POPs	Eliminate or reduce production, sale, use and release	National Implementation Plans, new candidates
	Mercury Program	Hg	Reduce emissions, including the use of mercury containing products	
UN	Basel Convention	Chemicals	Disposal of hazardous waste	
UN ECE	Heavy Metals Protocol (CLRTAP)	Pb, Hg, Cd	Reduce emissions to 1990 level	Phase out of leaded petrol, reducing emissions of mercury containing products
	POPs Protocol	POPs	Eliminate discharges, emissions and losses	Waste management, reducing emissions, new candidates
OECD	Product and chemical safety programmes	chemicals	Share information	Tests, reports, guidance manuals

3.1.1 SAICM

The Strategic Approach to International Chemicals Management (SAICM) adopted in 2006 in Dubai by the International Conference on Chemicals Management (ICCM) and endorsed by the UNEP Governing Council aims to achieve sound management of chemicals throughout their life-cycle so that by 2020 chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and on the environment. The overarching policy strategy in the SAICM work focuses to ensure that information on chemicals throughout their life cycle is available for all stakeholders. The information should, where appropriate, also include products. According to the SAICM Global Plan of Action, articles and products containing hazardous substances should all be accompanied by relevant information for users, workplaces and at disposal sites, which means that new measures need to be global in order to be effective. (SAICM 2006, 2009)

In connection to the SAICM work, an informal international workshop on stakeholders' information needs on chemicals in articles was held in January 2009 to start a dialogue at the international level to get a better picture of chemicals in articles and the related problems. The work includes collecting the different stakeholders' needs for information related to products and establishing a working group on chemicals in articles within the SAICM and ICCM2 framework. To support the work, case studies are carried out on selected product groups (building products, electronics, textiles and toys).

3.1.2 IFCS

Intergovernmental Forum on Chemical Safety (IFCS) is a mechanism to develop and promote strategies and partnerships between national governments, intergovernmental and non-governmental organisations with the purpose to provide policy guidance, develop strategies, foster understanding and promote policy support. IFCS contributes to the implementation of SAICM. (IFCS 2009)

3.1.3 UNEP Convention on Persistent Organic Pollutants (Stockholm Convention)

The Stockholm Convention on Persistent Organic Pollutants administered by UNEP was adopted in 2001 and it came into force in 2004. The Convention is aiming to eliminate or reduce the production, sale, use and release as well as unintentional formation of POPs [6], and is implemented through National Implementation Plans. All sources of chemicals are covered, including the use of products. An exception has been granted for DDT to control malaria. (Convention 2009, Steiner et al. 2003)

3.1.4 UNEP Mercury Program

The UNEP mercury program was established in 2003, based on a voluntary action, to reduce global mercury releases and the associated risks to humans and the environment. An internationally binding convention to reduce the global releases of mercury is under way, and the aim is to work on prioritized areas on industrial sources, on trade and use of mercury and mercury containing products as well as on waste handling. (UNEP 2009b)

3.1.5 Basel Convention

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal came into force in 1992 and is ratified by 172 countries. The target is to protect the environment from the inappropriate disposal of toxic waste (including discarded products) that includes hazardous chemicals.

3.1.6 UNECE Convention on Long Range Transboundary Air Pollution

The UNECE CLRTAP has several protocols related to the restriction of chemicals released from products. Releases from products covered by the VOC protocol are quite well known while product use related releases falling under the Heavy Metals and Persistent Organic Pollutants Protocols are not yet included in all national inventories.

3.1.7 Heavy Metals Protocol

The Protocol on Heavy Metals under the UNECE Convention on Long-Range Transboundary Air Pollution was adopted in 1998. The Protocol is aiming for limiting emissions of lead, mercury and cadmium. The Parties to the protocol have to reduce their emissions for these metals below their 1990 levels. Besides cutting emissions from industrial sources the Protocol also includes phasing out of leaded petrol and measures for reducing emissions from other products like mercury containing batteries. The protocol includes measures for management of other mercury containing products like electrical components, measuring devices, fluorescent lights, paint, pesticides and dental amalgam. (UNECE 2009a)

[6] The first stage of implementation targets the twelve most toxic POPs (pesticides: aldrin, dieldrin, endrin, DDT, heptachlor, chlordane, mirex and toxaphene; industrial chemicals: HCB and PCBs; industrial byproducts: PCDD/F). New candidates considered include penta-BDE, chlordecon, hexabromo-biphenyl, lindane, PFOS, alfa-HCH, beta-HCH, PeCB and octa-BDE.

3.1.8 Protocol on Persistent Organic Pollutants

The Protocol on Persistent Organic Pollutants (POPs) under the UNECE Convention on Long-Range Transboundary Air Pollution was adopted in 1998. The Protocol aims to eliminate any discharges, emissions and losses of certain pesticides, industrial chemicals and byproducts/contaminants. For some POPs the production and use is banned while the use of others is restricted and these will be phased out later stage. The Protocol also includes dealing with wastes of the eliminated POPs and obligates the Parties to reduce their emissions below the 1990 levels. Work to identify new candidate chemicals is underway (UNECE 2009b).

3.1.9 OECD

OECD has several work areas related to releases from the use of products, for instance the work on the management of perfluorinated chemicals (PFCs), pesticides, biocides and nanoproducts, as well as in the field of environmental exposure assessment and related to PRTRs.

Extended Producer Responsibility (EPR), also known as "Product Stewardship" is a concept for products, which extends its impacts beyond the emissions and effluents generated by the extraction or manufacturing processes to the management of the product once it is discarded. It is based on the premise that the primary responsibility for waste generated during the production process (including extraction of raw materials) and after the product is discarded, is that of the producer of the product. Costs related to pollution and to consumption of resources and energy, as well as to disposal, are subsidized by the government and are therefore not reflected in the price of the product. EPR corrects that imbalance by internalizing these externalities, and in doing so, shifts these costs from government and taxpayers to producers and consumers. EPR can be implemented in regulatory or voluntary forms. OECD has published several reports since 1994, and in 2001 a Guidance Manual for Governments on information about issues and potential benefits associated with EPR (OECD, 2009b).

The purpose of OECD's Co-operation programme on the Investigation on Existing Chemicals (HPV Chemicals Programme) is to share the burden among Member countries. The countries and the chemical industry collect information, test and carry out initial assessment of high volume chemicals in order to identify those for which further action is necessary (OECD, 2009c). From 1993 to 2013, the Programme – eventually called the Cooperative Chemicals Assessment Programme (COCAP) - produced more than 1300 agreed assessments of the hazards of chemicals, but, by the end of this period, priorities had shifted. In 2014, OECD countries agreed that the future COCAP should focus on (1) the development and application of integrated approaches to testing and assessment, that make best use of alternative methods such as in vitro methods, grouping of chemicals and quantitative structure-activity relationships, and (2) the exchange of knowledge and experience on the methodologies for assessing the risks from the combined exposure of multiple chemicals.

3.1.10 European Union

In the European Union, work is carried out to assess risks related to product safety as well as to implement related legislation (Table 9).

3.1.10.1 Risk assessment work

The EU carries out risk and safety assessments for products to ensure the safe use to the consumers and has established agencies and committees of independent scientific experts to conduct the assessments.

The Scientific Committee on Consumer Safety works on risks related to non-food consumer products (e.g. cosmetics, toys, textiles and clothing as well as personal care and household products). The work of the

Committee on Health and Environmental Risks targets to pollutants with possible negative impacts on health and the environment (e.g. the toxicity and eco-toxicity of chemicals). The Committee on Emerging and Newly-Identified Health Risks works on emerging or newly identified health and environmental risks (e.g. antimicrobial resistance, nanotechnology and medical devices). Harmonised risk assessments on substances related to the REACH legislation are carried out by European Chemicals Agency (EU 2009b).

3.1.10.2 Legislation

An overview of EU legislation related to chemicals in products is compiled in Table 9.

The recent EU REACH[7] regulation ((EC) No 1907/2006) requires the manufacturers and importers to take responsibility for the use of chemical substances and to improve the information flow on hazardous substances in different product groups throughout the supply chain. If an article[8] contains a substance which is intended to be released during normal use conditions and if the substance is manufactured more than one tonne per year per manufacturer/importer, the substance need to be registered. The registration includes information about the toxicity of the substance and its use in the article. If the article contains substances of very high concern (SVHCs[9]), the manufacturer or importer is obliged to notify the presence of the substance in an article and provide information on the concentration[10]. This is not required if the exposure to humans or the environment can be avoided under normal use conditions or if the substance has already been authorised for the specific use. If an article contains SVHCs at a concentration of more than 0.1% by weight, the supplier has to provide sufficient information (at the minimum the name of the substance) to the recipient (e.g. industrial/professional users and distributors) of the article, on substances at any quantity, to allow safe use. Information must be provided to consumers upon request within 45 days. REACH does not apply to waste, but recycled materials that become secondary products are included in the regulation.

Table 9. Overview of EU legislation related to chemicals in products

Legislation no.	Legislation name	Abbreviation	Aim
2001/95/EC	General Product Safety Directive	GPSD	Safety of products placed on the market
2009/251/EC	Decision on dimethylfumarate		Restriction of dimethylfumarate (DMF) in consumer products (e.g. leather furniture and footwear)
88/378/EEC and 2009/48/EC	Toys Directive		Safety of toys
89/106/EEC	Construction Products Directive	CPD	Safety of construction products
76/768/EEC and (EC) No 1223/2009	Cosmetics Directive and Regulation		Safety of cosmetic products (e.g. fragrances, UV filters and heavy metals)

[7] REACH, Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals came into force in the EU Member States in 2007. Note that Annex XVII of REACH replaces the earlier Limitations Directive 76/769/EEC.

[8] Article = an object , which during production is given a special shape, surface or design that determines its function to a greater degree than does its chemical composition

[9] SVHCs include substances found to be carcinogenic, mutagenic or toxic to reproduction, persistent, bioaccumulative and toxic (PBT) or very persistent and very bioaccumulative (vPvB) as well as those for which there is scientific evidence for similar concern (ECHA 2009b; ECHA 2008). They are listed on the so-called Candidate list for authorization (ECHA 2009a), which is regularly updated. (Art 57)

[10] When exceeding 0.1 weight-% and more than 1 tonne per year

2005/32/EC and 2009/125/EC	Energy-Using Products Directive	EuP	Ensure the free movement of energy-using products on the market, as well as to increase protection of the environment, energy efficiency and the security of energy supply
(EC) No 1907/2006	Registration, Evaluation, Authorisation and Restriction of Chemicals	REACH	Improve information flow on substances in products through the supply chain Reach Annex 17 (chemical specific restrictions, examples: As+Cr in treated wood; Pb containing paint, varnish etc.)
(EC) No 1272/2008 (67/548/EEC and 1999/45/EC)	Classification, Labelling and Packaging of substances and mixtures	CLP	Harmonize the classification and labelling of hazardous chemicals in the EU area (replaces the dangerous preparations and substances directives)
(EC) No 440/2008	Regulation for test methods		Test methods for REACH
2000/60/EC	Water Framework Directive	WFD	Reduce the pollution of ground and surface waters by reducing releases of certain priority hazardous substances
98/8/EC and new Regulation	Biocidal Products Directive and new Regulation	BPD	Biocidal products on the market (e.g. disinfectants, preservatives and pest control products)
91/414/EEC and (EC) No 1107/2009; 2009/128/EC	Plant protection products Directive and new Regulation; Framework Directive on sustainable use of pesticides		Plant protection products (e.g. herbicides, insecticides and fungicides) on the market
(EC) No 850/2004	POPs regulation	POP	Protect human health and the environment from persistent organic pollutants subject to the Stockholm Convention or the UNECE CLRTAP POPs Protocol
2002/95/EC and 2002/96/EC	Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment; and Waste Electrical and Electronic Equipment	RoHS and WEEE	Restrict of certain hazardous substances (Pb, Hg, Cd, Cr(VI), PBB, PBDE) in electrical and electronic equipment; reduce environmental impact of electronic waste and optimize collection, re-use and recycling
2000/53/EC	End-of-Life Vehicles	ELV	Reduce amount of hazardous waste, increase recycling and re-use of end-of-life vehicles (Pb, Hg, Cd, Cr(VI))
2006/66/EC	Directive on batteries & accumulators and waste batteries and accumulators		Maximize separate collection of waste batteries and accumulators and increase recycling level (Hg, Cd, Pb)
94/62/EC	Directive on packaging and packaging waste		Production, recycling and re-use of packaging waste (Pb, Cd, Hg, Cr(VI))
98/70/EC	Directive on the quality of petrol and diesel fuels		Reduce pollution from vehicles (Pb, S)
98/83/EC	Directive on the quality of water intended for human consumption		Protect human health from contamination (e.g. heavy metals) of water intended for human consumption; water distribution system (e.g. pipes, solders and joints)
84/500/EEC and 69/493/EEC	Directive relating to ceramic articles intended to come into contact with foodstuffs; and Directive relating to crystal glass		Migration of Pb and Cd from ceramic articles; defines the characteristics (e.g. Pb content) of crystal glass
86/278/EC	Directive on the protection of the environment when sewage sludge is used in agriculture		Use of sewage sludge in agriculture (Cd, Cu, Ni, Pb, Zn, Hg, Cr)

(EC) No 466/2001, 88/344/EEC and 88/388/EEC	Directives on the contaminants in foodstuffs; extraction solvents used in the production of foodstuffs and food ingredients; and flavourings for use in foodstuffs		Level of contaminants (e.g. Pb, Cd, Hg) in foodstuffs; use of extraction solvents in production of foodstuffs and food ingredients; content of flavourings in foodstuffs (As, Pb, Cd, Hg)
96/82/EC	Directive on the control of major-accident hazards involving dangerous substances		Prevention of major accidents involving dangerous substances (e.g. fluorine and lead alkyls)
89/391/EEC	Directive on the introduction of measures to encourage improvements in the safety and health of workers at work		Prevention of occupational risks, protection of safety and health

3.1.11 Nordic countries

3.1.11.1 Case – Norway

The Norwegian Environment Agency carries out regular inventories on releases from selected chemicals into the environment. The work is based on data available at the Norwegian product register[11] to which operators report their production and import of hazardous chemicals. The product register includes chemical products but not all products that are used in households. Examples include pharmaceuticals, textiles, electronics, furniture, cosmetics, or for example, substances used in the garden and garage.

The calculation model used to quantify releases to the environment from products, assumes for certain products that the same amount of chemical that was originally put in the product may be released into the environment during the use of the product. For certain other products, the model assumes that chemicals in another product will stay in the product without leaking or with minimal leaking during the use, or the leaks occur only in waste handing processes and do thus not end up directly in to the environment but through point sources, which are included in reporting as PRTR facilities. The results of the calculation model show that 99% of total annual releases of hazardous chemicals from the use of products are caused by products sold to households or retail sellers for sports use, leisure activities and for use in private households. The results are annually published by Norwegian Environment Agency in the publication series Hazardous Substances in Products (Miljøgifter © produkter)[12].

In the Norwegian inventory, chemicals have been classified as (1) environmentally harmful, (2) carcinogenic, mutagenic and reprotoxic (CMR), (3) chronically toxic and (4) allergy-causing chemicals. Some chemical releases are accounted for in more than one of these classes as the chemical can have several hazardous classifications. Examples of products that release these types of chemicals are presented in Table 10.

[11] SSB (2012) Utslipp av helse- og miljofarlige stoffer okte utslipp i 2010 Marte O. Kittelsen (2012) Helse- og miljøfarlige stoffer i faremerkede produkter. Kjemikalier i hverdagen – nyttige og farlige.

[12] http://www.miljodirektoratet.no/no/Publikasjoner/

Table 10. Examples of chemicals and products under the Norwegian hazardous chemicals classification

Classification	Examples of products	Examples of chemicals in these products
Environmentally harmful chemicals with long-term effects	bleaching, viscosity changing agents, impregnation and preservation agents in the industry, pesticides(conservation, disinfection and antifouling agents), antifouling compounds in fishing gear and hardeners used in construction and building products	creosote, dicopper oxide, dichlofluanid
CMR (carcinogenic, mutagenic and reprotoxic)	pesticides	creosote, formaldehyde, toluene
Chronically toxic chemicals	pesticides, fuels, solvents	toluene, carbon monixidem, phenol
Allergy-causing chemicals	pesticides, building and construction products, paint, varnish	formaldehyde, glutaraldehyde, kolofonium, ftalacidanhydrid

According to information in SSB 2012

According to the results of the Norwegian inventory, releases of chemicals classified as CMR (chronic toxic and allergy causing) have been decreasing since 2001 while release of environmentally harmful chemicals have been increasing (Figure 5). The increase is mainly due to increased use volumes of products that are estimated to stand for most of the releases of environmentally harmful chemicals (e.g. VOC containing products and pesticides). Other reasons are that plenty of new products containing environmentally harmful chemicals are every year reported for the first time into the product register and that prohibition of some of the dangerous substances has led to increased use of products "only" dangerous to the environment.

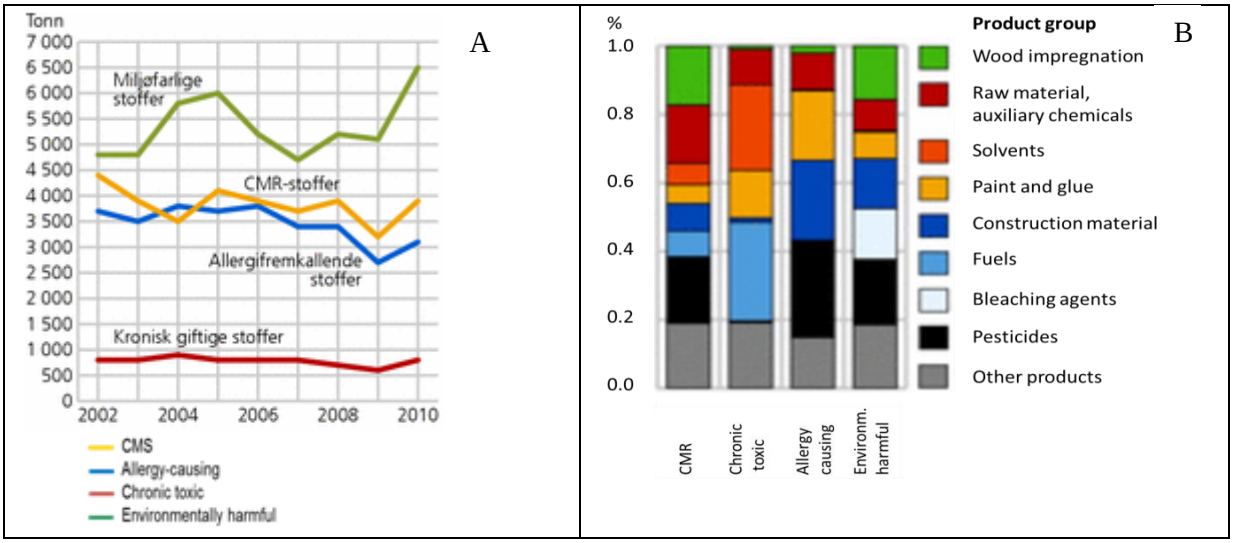

Figure 6. Examples of Norwegian analysis of chemical use and release data related to the use of products (SSB 2012)

A. Release trend of hazardous substances in Norway 2002-2010 (tons);

B. Releases (to all media) of hazardous substances by product and hazard class 2002-2010, in percentage of releases from all products.

3.1.11.2 Nordic experience of the impact of restrictions

While loads and impacts of some hazardous substances have been reduced considerably during the past 20-30 years, concentrations of several substances have increased in the marine environment. In the Nordic region, hazardous substances still poses risks to the Baltic Sea area (COHIBA, 2013).

In the Nordic countries, national restrictions for chemicals in products have gradually reduced the releases of restricted chemicals to the environment. Examples of chemical releases where products earlier had significant contribution and that have successfully been decreased during the last decades are lead from leaded gasoline and lead and cadmium from brake linings. For instance in Sweden, releases from brake linings have decreased to one tenth between 1998 and 2005 due to legislation (Hjortenkrans et al., 2008; Månsson et al. 2008) and similar trends are visible in Denmark, Finland and Norway.

Content of hazardous substances in consumer products are strongly regulated, and, when containing harmful chemicals, the products are well labeled. However, despite of this, products can still be important sources of emissions of hazardous substances. This was observed in the Norwegian inventories (SSB 2012), which show that the number of products containing hazardous substances has not decreased though the total releases of many of the specific chemicals in the Norwegian priority list of hazardous chemicals have decreased.

Even though efficient restrictions are in place for hazardous chemicals in domestically produced products and articles, environmentally harmful chemicals are still found in imported products, such as nonylphenols in towels, brominated flame retardants in electronics, furniture and textile and phthalates in PVC products (Bergbäck and Jonsson 2009). There are also products, where hazardous chemicals are not yet fully replaced due to their specific properties, such as mercury in measurement and control equipment (COHIBA 2011).

The replacement of the restricted chemicals has sometimes led to increased use of other chemicals that may be even more harmful to the environment than the originally used chemicals were. For instance, the replacements for brominated flame retardants (BRFs), such as PBDE, may have other BFRs that later proved to be harmful to the environment.

Other examples are the replacement of CFC and TBT. CFC, which was used as refrigerant, was replaced by HCFC and HFCs that have harmful effects ozone layer and strong GHG effects. (Swedish EPA, 2013; SSB 2012; CCOHS 2013). TBT was earlier used worldwide in boat under sealing treatment but has been forbidden since in the Nordic countries. TBT is nowadays mainly replaced with copper based treatment material, which release copper that is a harmful heavy metal, to the environment. A RET for copper releases from these antifouling agents is presented in Chapter 3.2 of this document.

3.1.12 Regional organisations

Overviews of European regional organisations that target to decrease chemical releases from products are listed in Table 11.

The Helsinki Commission (HELCOM), working on the protection of the marine environment of the Baltic Sea, has recommendations related to prevention of releases of hazardous substances from any sources, including those from the use of consumer products (HELCOM 2009).

The OSPAR Commission works on the protection and conservation of the marine environment of the North-East Atlantic, including prevention of releases of hazardous substances from diffuse sources, such consumer products (OSPAR 2009).

The Arctic Monitoring and Assessment Programme (AMAP) give guidance on prevention of pollution of the Arctic region, including releases from products (AMAP 2009).

Table 11. Regional restrictions relating to releases from products

Convention/Programme	Target	Region
HELCOM	Marine environment	Baltic Sea
OSPAR	Marine environment	North-East Atlantic
AMAP	Arctic environment	Arctic region

3.2 National legislation

Many countries have legislation either addressing the chemical content of end products or related to certain product groups as shown in Table 12 (by country) and Table 13 (by product group). For the EU region, only national legislation in EU Member States that exceeds the EU legislation has been included while EU wide legislation is presented in Table 9.

Table 12. National legislation concerning chemical content of products or product use

Country	Restriction
Australia	• Safety and information standards under the Trade Practices Safety Act from 1974 (IFCS 2006).
Canada	• Hazardous Products Act from 1969 administered by the Health Canada (IFCS 2006) • Ban on manufacture of polybrominated diphenyl ether (PBDE); prohibits the use, sale, offer for sale and import of those PBDEs that meet the criteria for virtual elimination under CEPA 1999 • Provincial legislation: Ontario's Toxics Reduction Act (Bill 167) is a part of the province's Toxic's Reduction Strategy, target to reduce toxics in the air, water, land and consumer products, includes tracking and evaluating the current uses and releases of toxics (Ontario 2008, 2009)
Chile	• Pb content in paint and petrol
China	• China RoHS (Pb, Hg, Cd, Cr (VI))
Denmark	• General national ban on certain Pb containing products in Denmark.
Finland	• Hunting Act (1993/615) prohibits the use of Pb containing shots for hunting waterfowls (since 1996). • Restrictions by the Consumer Agency for indoor use of Pb containing candle wicks

Japan	• Law for Ensuring the Implementation, Recovery and Destruction of Fluorocarbons Concerning Specified Products (restriction on vehicle air conditioning unit). • Standard for elution of lead from dish and toy is established under the food sanitation law.
Korea	• Pb compounds (De Minimis Limit 0.06% for metal accessories for children, since June, 2011).
Netherlands	• The use of Pb in ammunition for sports prohibited since 2004.
Norway	• Product Control Act to prevent damage to health and disturbances to the environment caused by products. Applies to manufacture, import, marketing, use and handling of products and consumer services. Product Regulations on the manufacture, import, export, sale and use of chemicals and other products hazardous to health and the environment. Restricted substances and preparations include e.g. PCBs, Pb, Hg, Cd, NP/NPE and PFOS and restricted product groups e.g. textiles, jewelry, impregnated wood, toys, batteries, vehicles, electrical and electronic equipment, paints and varnishes. (SFT 2009b)
Sweden	• Non-Toxic Environment is one of the environmental quality objectives: newly manufactured products should not contain substances of very high concern, e.g. persistent, bioaccumulative, carcinogenic, mutagenic, toxic to reproduction; endocrine disrupting; severely allergenic; Hg, Cd and Pb. Products already existing must be handled so that the substances are not released into the environment. (KemI 2006b; Konsumentverket 2006) • Environmental Code and Product Safety Act: companies placing products on the Swedish market are responsible for ensuring that the articles are not harmful for human health or the environment and to replace the chemicals that pose risks with safer alternatives. (KemI 2009b) • Chemical Products and Biotechnical Organisms Ordinance and Chemical Products Ordinance are based on the Environmental Code (Konsumentverket 2006). • In addition to EU legislation, there are specific national restrictions concerning Hg, Cd and trichloroethylene (Chemical Products (Handling, Import, and Export Prohibitions) Ordinance (1998:944) and Chapter 5 of the Chemical Products and Biotechnical Organisms Regulations (KIFS 2008:2) (KemI 2009h): • General national ban on Hg and products containing Hg (from 1.6.2009): placement of Hg, Hg containing compounds, preparations and articles on the market, use of Hg, professional exportation of Hg and articles containing Hg from Sweden. The ban does not concern items already in use, but these are not allowed to be placed on the market, exported from Sweden or to be refilled with new Hg. Exceptions due to harmonized EC legislation include e.g. light sources and other electrical and electronic products, batteries and vehicles. Time-limited exceptions for analyses chemicals, certain instruments, equipment and certain use of amalgam. Transition period to industry until 2013. (KemI 2009b) • Chemical Products Ordinance: products containing cadmium used as surface treatment, stabilizer or colorant are not allowed to be sold or imported. There are exemptions to this rule. (KemI 2009b)
Switzerland	• Ordinance on Risk Reduction related to the Use of certain particularly dangerous Substances, Preparations and Articles (Ordinance on Risk Reduction related to

	Chemical Products (ORRChem) of 18 May 2005).
Turkey	• Legislation addressing substances in products
United States	• Toxic Substances Control Act (1976): US EPA has the right to prohibit the manufacture, processing or distribution of a substance for a particular use or particular use above a certain concentration if the use results in an unreasonable risk to people (IFCS 2006). • The Federal Hazardous Substances Act bans the use of hazardous substances e.g. in toys (IFCS 2006) • California's Safe Drinking Water and Toxic Enforcement Act (1986) provides annual lists of appr. 775 chemicals "known to cause cancer or reproductive toxicity", it is required that businesses provide warnings (label, signs, distributed or published notices) when a product, drinking water or workplace is exposing people to the chemicals on the list, if the exposure levels exceed a "no observable effect level" divided by 1,000. Due to this some products in the California market are labeled as "This product contains chemicals known to the state of California to cause cancer or reproductive toxicity".(Massey et al. 2008) • In 2008, Bills A.B 1879 and S.B. 509 in California set a framework for a "green chemistry" program to reduce/phase out toxic substances in consumer products and the environment and to manage information on toxic chemicals. Authorities can regulate chemicals in consumer products by developing a program to identify and prioritize chemicals of concern and to analyze safer alternatives. Toxics Information Clearinghouse established for increasing consumer knowledge on risks related to everyday chemicals (Whetzel 2008; Massey et al. 2008). • Many US states have restrictions on the use of mercury in articles. E.g. Massachusetts requires manufacturers to identify and label Hg containing components of their products and the amount of Hg in them and selected mercury containing products will be phased-out; Maine has banned the use of Hg and Washington has an Hg reduction legislation. (Massey et al. 2008, Costner et al. 2005). • In 2004 penta- and octa-BDE were taken off the market by a voluntary agreement by the industry. Several states have banned these substances by law. Legislation for the use of safer cleaning products in public buildings, and legislation requiring toxics use reduction for large user segments. (McPherson et al. 2004; Sharp & Lunder 2004).

Table 13. National restrictions for product groups (for EU Member States beyond EU legislation)

Product group	Restriction	T= Total ban [13] R=Restriction	Region	Year	Chemicals included
Ammunition	Use of Pb shots banned for hunting waterfowl	T	Finland	1996	Pb
	Manufacture, import, export, sale and use of Pb shots is banned (including target ranges)	T	Norway	2005	Pb
	Restrictions on the use of Pb shots for clay target shooting	R	Denmark, Sweden		Pb

[13] Can include exemptions

	Restrictions for the use of Pb in ammunition for rifles	R	Sweden	2008	Pb
Cable sheathing	Prohibition on Pb cable sheaths for ground cables below 24 kV	T	Denmark		Pb
Candle wicks	Pb in candle wicks banned	T	US, Australia, Denmark		Pb
	Restrictions for indoor use	R	Finland		Pb
Capacitors and transformers	Prohibition on the use of ballast capacitors containing PCB	T	Norway	2005	PCBs
Dental amalgam	General national ban for Hg containing products	T[17]	Sweden	2009	Hg
Electrical and electronic equipment	General national ban for Hg containing products	T	Sweden	2009	Hg
	China RoHS	R	China		Pb, Hg, Cd, Cr (VI), PBB, PBDE
Fishing gear	Certain use of Pb sinkers prohibited	T	UK		Pb
	Use of Pb in fishing equipment is banned in national parks	T	Canada		Pb
	Total ban on the use of Pb in fishing equipments	T	Denmark		Pb
	Voluntary restriction on the use of Pb sinkers in certain fresh waters	R	Sweden		Pb
Glasses and glazes	Tableware Act	R	California		Pb
	Use of Pb in gasoline banned for in-road vehicles	T	USA	1996 (1990)	Pb
	Restriction on the Pb and Cd released from glazed ceramics and glassware	R	Canada	1971 revised 2005, 2009	Pb, Cd
	Restriction on Pb released from kettles	R	Canada	1974 (pending amendment 2010)	Pb
	Use of Pb solder in food cans is prohibited	T	USA		Pb
	Use of Pb foil wrappers banned	T	US		Pb
	Prohibition on the import and marketing of Pb containing security/safety seals	T	Denmark		Pb
	Toxin-Free Toddlers and Babies Act to ban the use of bisphenol-A in baby bottles	T	California	2009	bisphenol-A
	Voluntary industry initiative to stop using bisphenol-A in baby bottles	T	USA	2009	bisphenol-A
	Prohibition on the sale, advertising or importing into Canada of polycarbonate baby bottles that contain BPA	T	Canada	2010	BPA
Paint	Sale of Pb containing residential paints banned	T	USA	1978	Pb
	Limit values for the Pb content of paint	R	USA	2009	Pb
	Ban on the use of Hg containing paint	T	USA	1991	Hg
	Limit values for the Pb and Hg content in surface coating materials	R	Canada	1976 amendments 2005	Pb, Hg
Pesticides	Use of Pb arsenate as insecticide banned	T	US	1988	Pb

PVC plastics	Import and marketing of the use of Pb compounds in e.g. PVC cables, gutters, pipes, roofing and windows (general national ban on Pb)	T	Denmark	2003	Pb
Radiation shielding	Restriction on the Pb content of radiation shielding (including cathode-ray tubes)	R	Norway		Pb
Roofing and flashings	Use of Pb around windows and chimneys is banned (general national ban on Pb)	T	Denmark	2000	Pb
Sealants and caulk	Ban on new use of PCBs (including double glass windows)	T	Norway	1980	PCBs
Textile and leather	Proposed a law to ban the use of Cr(VI) in leather products intended for more than temporary contact with skin	T	Germany		Cr (VI)
Toys	Law to ban the use of certain phthalates in toys and child care articles	T	California	2009	DINP, DEHP, DBP, DIDP, DNOP, BBP
	Limit values for the Pb content of toys	R	USA	2009	Pb
	Limit values for the Pb content of children's jeweler	R	California	2007	Pb
	Proposed a law to ban on the use of Cr(VI) in leather toys	T	Germany		Cr (VI)
	Hazardous Products Act limits the amount of Pb in children's jewelry and other non-toy children's products (e.g. furniture)	R	Canada	1970	Pb
	Hazardous Products Act limits the amount of Sb, As, Cd, Se, Ba, and Pb used in children's toys	R	Canada	1970	Sb, As, Cd, Se, Ba, Pb
	Limit values for the Pb content of toys (not jewelers)	R	China		Pb
Vehicles	Prohibition on the import and marketing of Pb containing brake linings	T	Denmark		Pb
	Voluntary National Lead Free Wheel Weight Initiative	R	US		Pb
Water pipes	Prohibition on the import/ marketing of Pb containing solder for use in plumbing and sanitation (except for Zn sheets)	T	Denmark		Pb
Weights	Ban on Pb containing curtain weights (general national ban on Pb)	T	Denmark	2000	Pb

In addition to product group related restrictions listed in Table 10, several products fall under other EU legislation, such as the REACH and POP Directives. Examples of this type of products and chemicals are PCB use in capacitors and transformers, lead use in paint, sealants, lacquer and varnishes, lead containing glazes, enamels and pigments on certain ceramics, as well as arsine and chromium use in wood treatment.

3.3 Work by the Industry

The industry carries out voluntary initiatives regarding the use of chemicals in products and their possible releases. Examples of this type of work can be found, for instance, in the apparel, electronic and building industries (Table 14).

Table 14. Examples on industry initiatives on releases from products

Organisation/ area	System	Target
International Council of Chemical Associations ICCA	Global Product Strategy GPS	Product stewardship information, reporting to the public
	Responsible Care and Responsible Care Global Charter RCGC	Effective management of chemicals
	Global initiative for HPV chemicals	Testing of chemicals and assessment of possible hazardous properties
Cefic	Confidence in Chemicals and HPV Chemicals	Chemical properties, impacts
Construction industry and IVL in Sweden	BASTA	Database for 13,000 registered materials that meet the requirements of health and environmental properties
Industry	Restricted substances lists (for health, safety and the environment)	Lists of substances prohibited / restricted or preferred in the products

3.3.1 Responsible Care and Responsible Care Global Charter (RCGC)

The Responsible Care Programme (RCGC), started in 1985, is a global voluntary initiative for sustainable development by the chemical industry (International Council of Chemical Associations, ICCA), which has been implemented in 53 countries. The RCGC commits companies to work together to enhance the health, safety and environmental performance of their products. It focuses on effective management of chemicals, greater industry transparency and greater global harmonization of the national programmes. (Responsible Care 2009)

3.3.2 Global Product Strategy (GPS)

The Global Product Strategy (GPS), linked to the RCGC programme, enhances product stewardship within the chemical industry along with suppliers and customers. The aim of the programme is to ensure the benefits of the products while improving the protection of human health, safety and the environment. GPS includes sharing of best practices, risk management of chemicals and greater transparency of the industry.

3.3.3 Confidence in Chemicals and the global initiative on HPV Chemicals

The Confidence in Chemicals initiative was launched by the chemical industry in 1998 as part of the Responsible Care programme, and is aiming to inform the stakeholders about the effects of chemicals and the precautions taken to ensure the safety of products. The work is coordinated by the CEFIC (European Chemical Industry Council). The aim of the programme is to speed up the testing of HPV chemicals[14], by completing data sets and hazard assessments for approximately 1000 HPV chemicals in partnership with the OECD HPV Chemicals Programme (Chemical Industry 2009, ICCA 2009a; Finer 2006).

3.3.4 Voluntary Emissions Control Action Programme (VECAP)

Voluntary Emissions Control Action Programme (VECAP) is a global chemical management programme implemented in the Asia-Pacific region, Europe and North America. VECAP's mission is to increase the

[14] HPV chemicals = chemicals produced in more than 1000 tonnes per year per producer

awareness of chemical handling processes throughout the value chain with increasing understanding of chemicals management beyond existing legislation, promoting and facilitating dialogue between the industry, regulators and stakeholders and by raising the awareness of all personnel throughout the supply chain. (VECAP, 2010)

3.3.5 BASTA project on construction and building products

The Swedish Construction Federation, the Swedish Environmental Research Institute IVL and the four largest construction companies in Sweden have a joint project, BASTA, funded by the EU's environmental fund LIFE. The project aims at phasing out construction and building products containing hazardous substances by developing a new classification system for these products based on their chemical content. The BASTA database contains currently approximately 13,000 registered materials self-declared by suppliers that meet the safety requirements set for health and environmental properties of the products. The substances to be registered must not be carcinogenic, mutagenic, toxic to reproduction, persistent in the environment or bioaccumulative. (BI 2003)

3.3.6 Restricted and preferred substances lists

Different industry sectors (e.g. electronic, automotive and apparel) have created lists of substances prohibited, restricted or preferred in their products. The companies need this information in planning their future projects. For instance, the car industry jointly operates a material data system IMDS[15] (see Chapter 4.5.3) helping to trace hazardous substances through all parts of cars. Examples of companies that maintain this type of databases are General Motors, Phillips, Ericsson, Nokia, Motorola, Scania, Wal-Mart and Volvo. For instance Scania[16] keeps a list of chemicals divided into those that should not to be used in any condition and to those that can be used under limited circumstances. Wal-Mart has made a Preferred Chemical Principles policy for product ingredients that indicates that the company favours products not containing carcinogens, mutagens or reproductive toxicants and those that are not persistent, bioaccumulative or toxic to the environment. The company has already identified three priority chemicals to be phased out by Wal-Mart (pesticides and nonylphenol ethoxylates) and is developing a screening tool to identify other chemicals of concern. (Peltonen 2005b, Massey et al. 2008)

3.4 Work by NGOs

Non-governmental organisations (NGO) carry out a number of projects and programmes concerning the health, safety and environmental impacts of releases from products (Table 15).

At international level, there are some groups involved in work with harmful impacts of products. For instance, Health Care Without Harm (HCWH) is an international coalition in more than 50 countries where health care professionals and environmental organisations work on restricting and preventing pollution from health care sector products.

In the USA and Canada there are several NGOs working in the field. Examples of these are the Clean Production Action (CPA) group working on green chemicals, sustainable materials and environmentally preferable products. The CPA also runs a Safer Products Project as a public support for the use of these chemicals. The Environmental Working Group (EWG) has projects related to hazardous chemicals in consumer products. The Healthy Building Network (HBN) is working on transforming the market of building materials to advance the best environmental, health and social practices. The Ecology Center of Ann Arbor tests chemicals used in cars and child seats for selected substances (antimony, arsenic, bromine,

[15] IMDS, International Material Data System

[16] Swedish company producing trucks, buses and engines

chlorine, chromium, cobalt, copper, lead, mercury, nickel and tin). The test results rating these products, as well as the full reports are available to the customers in a web page and database. (CPA 2009, HBN 2009, Massey et al. 2008)

In the Nordic countries, for instance in Sweden, the Swedish Society for Nature Conservation has carried out significant work in this field, for instance in testing releases of hazardous substances from products, e.g. textiles and shoes.

Table 15. Examples of NGO work related to releases from products

Country	NGO	Scope
International	Health Care Without Harm (HCWH)	Prevention of pollution in health care sector
Sweden	Swedish Society for Nature Conservation	Tests for textiles and shoes for the content of hazardous substances
USA and Canada	Clean Production Action (CPA)	Green chemicals, sustainable materials and environmentally preferable products
	Environmental Working Group (EWG)	Hazardous chemicals in consumer product, maintains Skin Deep database
	Healthy Building Network (HBN)	Building materials
	Ecology Center of Ann Arbor	Consumer Action Guide to Toxic Chemicals in Cars and child seats

4 INFORMATION SYSTEMS ON CHEMICALS IN PRODUCTS

4.1 Existing information systems on substances and end-products

Although information about the properties of individual chemicals can be received from the chemicals manufacturers, for example through the material safety data sheets, it is often difficult to receive information on the chemical content of products. Related to products, the variability of regulations in different countries and the lack of enforcement are challenges for this flow of information.

At the UNEP IFCS, work initiated by Japan and Sweden has been started to create a global system to collect information on chemicals in products. In this chapter, information is provided of some of the existing systems that include information on the chemical content of products, classification and labelling as well as life-cycle analysis data (examples of these systems are given in Table 16).

Table 16. Examples of existing information systems on substances and end-products

System	Maintenance	Information
Classification and labelling systems		
Globally Harmonized System (GHS)	UN	Classification and labelling of physical properties and toxicity of chemicals
Classification, Labelling and Packaging of substances and mixtures (CLP)	EU	Implementation of the GHS in the EU
SIN List (Substitute It Now)	ChemSec (International Chemical Secretariat)	Chemicals that fulfil the criteria of substances under the REACH, a tool for the work in substituting hazardous chemicals by safer alternatives in everyday products
Environmental labelling	National, UN, EU, ISO standard	Environmentally friendly products
National hazardous chemicals lists	EU Member States	Hazardous chemicals
Rapid alert system for non-food consumer products (RAPEX)	EU	Alert and information exchange on hazardous products
Life cycle assessment and Integrated Product Policy		
LCA and IPP	EU	Environmental impacts
Information on chemicals and substances		
Material Safety Data Sheet (MSDS)	International	Properties of chemicals
International Uniform ChemicaL Information Database (IUCLID)	EU	Properties of chemicals (contains the registration dossiers submitted by industry to ECHA under the REACH)
Product registers (e.g. registers containing information on chemical products)		
National product registers	E.g. Denmark, Finland, Norway and Sweden, United Kingdom, Cyprus, Switzerland	CAS numbers, product use volumes and area of use In the Nordic product registers by DK, FI, NO, SE also substances and mixtures
Interstate clearing houses and databases (IMERC)	USA	Mercury added products information systems, open to public
International Material Data System (IMDS) with Global Automotive Declarable Substance List (GADSL)	Vehicle manufacturers	Information on substances in vehicles in the supply chain.
Global Data Synchronisation Network (GDSN)	LANSA	Platform for companies to manage their product information

Cosmetics safety database (Skin Deep)	Environmental Working Group (EWG), USA	Information on safety on cosmetics and personal care products by researchers
Product safety work		
National product safety organisations	E.g. Canada, Denmark, Finland, Germany, Norway, Sweden, USA	Increase awareness to end-users of products
Database on product safety	Ecology Center of Ann Arbor	Tests results of chemicals used in cars and child seats
Database on product safety	Swedish Chemicals Agency	PRIO risk reduction database > 4,000 substances.
Source Ranking Database (SRD)	US EPA	Ranking of indoor pollution sources e.g. carpets, rugs, furniture, pharmaceutical preparations, soap and other detergents, paints, cosmetics and personal care products, coatings, pesticides, wall coverings, cleaning agents, textile finishes and flooring for phthalates, lead, tributyltin, adipates, NPEs etc.

4.2 Classification and labelling systems

4.2.1 Environmental labelling

4.2.1.1 Chemicals

The United Nations' GHS is a standardized system for international communication about chemical hazards. The purpose of GHS is to document information on the physical properties, toxicity and exotoxicity of chemicals as well as to enhance the protection of human health and the environment during handling, transport and use of chemicals. In the GHS system chemicals are classified based on the type of hazardousness (for example acute toxicity, carcinogenicity, reproductive toxicity, explosivity and acute environmental toxicity) with symbols (pictograms), signal words and hazard statements, also precautionary statements as well as product and supplier identification information are included. The aim of this information is to protect workers and the environment. (Massey et al. 2008, GHS 2009).

In the EU, GHS is implemented by the CLP regulation (EC) No 1272/2008 (Classification, Labelling and Packaging of substances and mixtures). The objective of the regulation is to determine which properties of substances and mixtures should lead to being classified and properly identified as hazardous. The properties include physical hazards, hazards to human health and to the environment. CLP will be applied in stages and it will eventually replace the old directives. The CLP regulation applies to all chemicals but the labelling requirement concerns only substances and preparations classified as hazardous. Unlike in REACH, there is no tonnage limit. The role of the European Chemicals Agency (ECHA) is to provide industry with technical and scientific guidance and tools on how to comply with the obligations laid down by the regulation. (CLP 2009)

4.2.1.2 Products

An eco-label for a product is often awarded by a third party to products or services meeting specified environmental performance criteria or standards.

4.2.1.2.1 ISO standards for eco-labelling

Voluntary eco-labelling is carried out according to ISO 14020 series Environmental labels and standards at three levels (ISO 2009; GEN 2004):

- Type I environmental label on a product is awarded based on life cycle assessment by a third party. Examples of eco-labels are the German Blue Angel, the European Union Flower and the Nordic Swan.

- Type II environmental self-declaration is developed by the producer, for example the "Energy Star".

- Type III environmental declarations provide quantified environmental data of product based on life cycle assessments by a qualified third party. Examples are report cards and information labels.

4.2.1.2.2 European Eco-label -The Flower

The EU Eco-label certification scheme assists consumers to identify environmentally friendly products and services, excluding food and medicine. There are currently 23 product groups including several hundred products that have over 300 licenses to use the label. The label cannot be granted to products containing substances or preparations/mixtures classified as toxic, hazardous to the environment, carcinogenic, mutagenic or toxic to reproduction (CMR), or to those included in Article 57 of the REACH regulation (ChemicalWatch 2009c). (Eco-Label 2009)

4.2.1.2.3 Nordic Eco-label -The Swan

The Nordic Eco-label by the Nordic Council of Ministers is meant to increase awareness on the environmental impacts of products and services and to direct consumption, marketing, product development and manufacture to a less harmful direction regarding the environment. The criteria are the same in all Nordic countries and include life-cycle assessment of the product considering consumption of natural resources and energy; harmful releases to air/water/soil, noise, smell; waste production and recycling. Products for which the manufacturers apply for the label are being checked by samples, certificates and control visits. The label is usually valid for three years after which the criteria are revised and the license has to be reapplied. The label is available for approximately 70 product groups and services including, for instance, button cell batteries, motors, lighting, washing-up liquids, washing machines, furniture and hotels. (SFS 1993, 2009).

4.2.1.2.4 German Eco-labels -The Blue Angel, Öko-Tex Standard 100

The Blue Angel is awarded by the German Environmental Label Jury to products, which are environmentally friendlier than other products serving the same purpose. Approximately 10,000 products and services in 80 product categories carry the Blue Angel eco-label. Examples of product groups are paints and varnishes wall papers, paper products, solar panels, low-noise appliances, heating systems as well as certain services such as wet cleaning of textiles. The basic award criteria for the different product groups are valid for a 3-t4-year period, and the award of the label is preceded by a life cycle assessment (The Blue Angel 2009a, b,c & 2009d).

Öko-Tex Standard 100 is a globally uniform testing and certification system for textile raw materials, intermediate and end products at all stages of production to ensure their safety regarding harmful chemicals to health. A tested textile product is allocated to one of the four Öko-Tex Product classes based on its intended use. The issued certificate applies one year at a time and can be renewed when required. (Öko-Tex, 2009)

4.2.1.2.5 American Eco-label (The Green Seal)

The Green Seal environmental certification standard covers more than 40 product categories, for example paints and coatings, household cleaning products, hand soaps and cleaners, paper towels and printing and writing paper. Services that carry the label are e.g. cleaning services and lodging properties. The label is awarded to products certified after accurate testing and evaluation, including on-site plant visits. (Green Seal 2009a & b)

4.2.2 National lists of hazardous substances

Countries have established lists for hazardous or undesirable substances. The lists are periodically reviewed and updated according to changes in the selection criteria. As examples of the lists, information of the Danish and Norwegian lists is presented below. In addition to the national lists, EU wide lists of hazardous substances are valid in the Member States.

Denmark published the first list of undesirable substances in 1998 and has revised it since on an ongoing basis. If the chemicals or products containing these chemicals are used for commercial purposes in Denmark, they must be reported to the Danish Product Register. The selection of substances to the list is based on their undesirable effects. Candidates for the list are for example carcinogens, mutagens, reproduction toxins and substances being toxic to aquatic life. The list includes about 70 substances and groups of substances, and provides information on chemicals, the use of which should either be reduced or stopped in the long term.

Norway has three lists of hazardous substances. The list of priority substances includes approximately 30 substances and groups of substances, including POP compounds (e.g. SCCPs and PFOS) and heavy metals (e.g. Pb, Hg and Cd). Releases of certain ecological toxins will be eliminated or substantially reduced by 2000, 2005 or 2010. Releases and use of substances that pose a serious threat to health or the environment will be continuously reduced with a view to eliminating them within one generation (by the year 2020). Priority is given to substances that have low biodegradability, which bioaccumulate and have serious long-term impacts on health, or are highly toxic to the environment. The observation list of 250 substances includes examples of substances that are particularly hazardous to health or the environment and are used in such amounts that they may present a risk at national level. The list of dangerous substances includes approximately 3,500 substances, which also fall under the EU classification.

4.3 Life Cycle Assessment (LCA) and Integrated Product Policy (IPP)

Life Cycle Assessment supports decision-making by describing interactions between the product and the environment. LCA is used in environmental labelling. Integrated Product Policy (IPP) is a general policy framework within the EU based on the life cycle approach, with the target to minimize environmental impacts of products during all phases of the product's life cycle.

4.4 Material Safety Data Sheets

Material Safety Data Sheets (MSDSs) are intended for the safe management of substances and contain information on the physical properties, toxicity, reactivity, storage, and disposal and health effects as well as on safe use and potential hazards of a certain material or product. The MSDSs are primarily intended for occupational use, not for consumers, and they are country and supplier specific.

4.5 Product registers

4.5.1 Nordic countries

The Nordic countries established a joint online database in 2002 on the use of chemical substances in products on the Nordic market (Substances in Preparations in the Nordic Countries, SPIN). SPIN is based on data from product registers from Denmark, Finland, Norway and Sweden. The declaration requirements vary between countries. The Danish and Swedish product registers contain information on the highest proportion of products on the market. Foodstuffs and medicinal products are exempted from the product registers in all countries. There are no requirements to declare solid processed articles and thus chemicals in textiles, chipboard, etc. are not included in the registers. However, if the articles are produced in the Nordic countries, the raw materials used may be declared. SPIN was financed by the Nordic Council of Ministers Chemicals Group.

4.5.2 Other European countries

In addition to the Nordic countries also Cyprus, Switzerland and the UK have product registers. Belgium and the Netherlands have Poison Information Centres, and Austria and Iceland carry out registering of material safety data (MSDS) sheets. Estonia collects information on HPV chemicals. France, Italy, Poland and Slovakia collect information on chemical substances and preparations in their national registers.

4.5.3 Industry

The International Material Data System (IMDS) is an online database of the automotive industry, designed to provide communication of information through the production supply chain. IMDS lists over 8,000 substances. It does not provide information to the consumers.

The Global Automotive Declarable Substance List (GADSL), included in the IMDS, contains 111 substances expected to be present in a vehicle. These substances are listed as "prohibited" or "declarable".

The Global Data Synchronisation Network (GDSN) is a platform for companies to manage information on chemical ingredients of products provided by the suppliers. To ensure products are classified correctly and uniformly, GDSN uses GS1 Global Product Classification (GPC), a system that provides buyers and sellers a common language for grouping products in the same way, everywhere in the world (GDSN, 2010, Massey et al. 2008)

4.6 Product safety work and other information exchange systems

There are both international and national information exchange systems regarding products that may bear risk to health, safety or the environment.

Product safety work can be organized by the government or based on the contribution of consumer organisations. Competent government bodies responsible for this work include, for example, health and product supervising authorities, authorities supervising chemicals and food products as well as customs authorities. Consumer protection authorities and plant production inspection authorities follow product properties. Information on the national organisation of product safety work in the different countries is presented compiled in Table 17.

4.6.1 Rapid alert system for non-food consumer products (RAPEX)

RAPEX is an EU system facilitating a rapid information exchange on preventing and restricting the use and marketing of products that pose a serious risk to the health and safety of consumers. All member states

use the RAPEX system for detecting and notifying dangerous products and for ensuring follow-up actions. The number notifications has gradually increased from year 2004 for instance, in 2008 the number of consumer products that were withdrawn from the market through the RAPEX system was 16 % higher (1,866 notifications) than in 2007. Also, recently it has been noticed that businesses recall their unsafe products more often than they did some years ago. Products with the most frequent notifications in 2008 were toys and child-care articles (498), electrical products (169), motor vehicles (160), all accounting together 53 % of the total amount of notifications. The number of notifications for textile products was 140. Countries that made most of the notifications in 2008 were Germany (205), Spain (163), Slovakia (140), Greece (132) and Hungary (129), representing together 50% of the total. The number of notifications on Chinese made products increased from 52 % in 2007 to 59 % (909 notifications) in 2008. (RAPEX 2009, EU 2009a)

The "RAPEX-CHINA" application (established in 2006) provides the Chinese authorities access to information on the Chinese products labelled as dangerous in the RAPEX system. The cooperation is conducted in the form of Memorandum of Understanding between the Health and Consumer Protection Directorate-General of the European Commission (DG SANCO) and the General Administration of Quality Supervision, Inspection and Quarantine of China (AQSIQ). Based on information provided in the system, the Chinese authorities have increased restrictive measures on their markets. AQSIQ has until now investigated 669 notifications, from which 53% (352 notifications) resulted in preventive or restrictive measures. (RAPEX-CHINA 2009, EU 2009a)

Table 17. Examples of product safety work

Country	Organisation	Examples of product groups
Canada	Global Public Health Intelligence Network GPHIN	
China	RAPEX-CHINA	Chinese products labelled as dangerous in the RAPEX
EU	Rapid Alert System for non-food consumer products (RAPEX) of products that pose danger to health and safety of consumers	Toys, child-care articles. electrical products, and motor vehicles, textile products etc.
Denmark	Danish Safety Technology Authority	Baby products, electrical products and fireworks
	Danish Consumer Agency	
	Danish Consumer Ombudsman	
	Danish Consumer Council	
Finland	Safety Technology Authority and Ombudsman	Furniture, toys, textiles and cosmetics
	Safety Technology Authority	Technical products (including electrical appliances, pressure and measuring equipment, rescue service equipment and CE-labelled construction products)
	Food Safety Authority	Products in contact with food/drink +pesticides/fertilizers
	National Supervisory Authority for Welfare and Health	Chemical products (e.g. cleaning agents, detergents and biocides)
	National Agency for Medicines	Pharmaceuticals and healthcare products
	The Finnish Vehicle Administration	Vehicle components and traffic equipment
	The Finnish Consumers' Association	
	The Consumers	
France	Consumer Safety Watchdog	
	Health Watchdog	
	French Agency for the Safety of Health Products	
	French Food Safety Agency	
	Federal Union of Consumers	
	Confederation for Consumer Affairs, Housing and Quality of Life	

Germany	The Federal Office of Consumer Protection and Food Safety	Plant protection products and medicinal products
	The Federal Institute for Risk Assessments	Foods, substances (e.g. cosmetics) and products
	The Federal Institute for Occupational Safety and Health	
	The Federation of German Consumer Organisations, the “Stiftung Warentest" and the “Verbraucherinitiative e.V.”	
Nether-lands	National Institute for the Safety of Food and (consumer) Products VWA	
Norway	Directorate for Civil Protection and Emergency Planning (DSB)	Central responsibility, distributes specified tasks to the below listes agencies
	Consumer Ombudsman	
	Food Safety Agency	
	Labour Inspection Authority	
	Public Roads Administration	
	Radiation protection agency	
	Norwegian Environment Agency (RAPEX)	
	Consumer Council	
Sweden	Swedish Consumer Agency	
	The Swedish Consumer's Association	
	The Swedish Consumer Coalition	
Thailand	Platform on Chemicals Safety	
United States	Federal Trade Commission	
	The Consumer Product Safety Commission	
	Department of Consumer Affairs (in the States)	
	Household Products Database	Car products, pesticides, products used in gardens, personal care, home maintenance, arts&crafts, pet care, home office etc.

4.6.2 Global Public Health Intelligence Network (GPHIN)

Global Public Health Intelligence Network (GPHIN) is an internet-based warning system on information about significant public health events, including exposure to chemicals and issues relating to the safety of products. GPHIN was developed by the Public Health Agency of Canada and is managed by the Agency's Centre for Emergency Preparedness and Response (CEPR) (GPHIN 2004).

4.6.3 Nordic countries

4.6.3.1 Denmark

The Danish Safety Technology Authority (Sikkerhedsstyrelsen), the Danish Consumer Agency and the Consumer Ombudsman control product safety related issues. The Danish Consumer Council, an umbrella organisation, is the main national consumer organisation in Denmark.

4.6.3.2 Finland

The Safety Technology Authority (Tukes) and the Consumer Ombudsman have the surveillance of consumer products, technical products and equipment as well as chemicals, explosives and fireworks on the market (Tukes 2009). Tukes also maintains a list of dangerous products on their website and tests on randomly selected products to identify possible safety risks. It is the customs' duty to supervise consumer products imported outside the European Economic Area[17]. Construction products that are not CE-labeled are supervised by the Ministry of the Environment. The Finnish Food Safety Authority (Evira) controls

[17] i.e. EU Member States, Norway, Iceland and Liechtensten

products that are in contact with food or drink as well as pesticides and fertilizers. The National Supervisory Authority for Welfare and Health (Valvira) and the Finnish Environment Institute control the enforcement of chemicals legislation, authorization of biocides and the regulation of detergents while the National Agency for Medicines has the responsibility regarding pharmaceuticals and healthcare products on the market. The Finnish Vehicle Administration (AKE) carries out surveillance of vehicle components and traffic equipment. There are two national consumer organisations, Finnish Consumers' Association (Kuluttajayhdistys) and the Consumers (Kuluttajat) (EC 2009b).

4.6.3.3 Norway

The Directorate for Civil Protection and Emergency Planning (Direktoratet for samfunnssikkerhet og beredskap, DSB) is the supervising authority together with the Consumer Ombudsman. The Consumer Council is the main national consumer organisation in Norway. Besides product safety, these organisations work with fire, electrical and chemical safety as well as emergency legislation issues. (TEM 2009; EC 2009b)

4.6.3.4 Sweden

The Swedish Consumer Agency (Konsumentverket) is the supervising authority while the fieldwork is carried out by national consumer organisations, including the umbrella organisations The Swedish Consumers' Association (Sveriges Konsumenter) and the Swedish Consumer Coalition (Sveriges Konsumenter i Samverkan). The Swedish Chemicals Agency (KemI) carries out research and follow-up work on chemicals in articles/products. KemI publishes information on national product use related issues such as product types dangerous for the environment, imported and domestic produced products and top ten lists of the most common types of products and chemicals. KemI publishes the Commodity Guide which contains information on materials and substances that may be included in commodities on the Swedish market. KemI has developed a risk reduction tool, Prio, including a database containing more than 4,000 substances. The hazardous substances are divided into those that should be phased-out and to prioritized risk reduction substances. Prio shows if the substance is included in the REACH candidate list or prioritized in the Water Framework Directive. The Agency's restricted substances database contains information on prohibitions and restrictions of substances and the classification database contains approximately 3,300 substances. (KemI 2004b, EC 2009b)

4.6.4 Other European Countries and the EU

4.6.4.1 Germany

The Federal Office of Consumer Protection and Food Safety, the Federal Institute for Risk Assessments and the Federal Institute for Occupational Safety and Health are the main federal agencies working on product safety issues. There is no central supervisory authority for consumer protection in Germany. The 16 federal states are responsible for enforcement of legislation. There are also government-funded private organisations working alongside the government bodies. The Federation of German Consumer Organisations, the “Stiftung Warentest" and the “Verbraucherinitiative e.V.” are national consumer organisations working at federal or regional level in Germany. The Federation of German Consumer Organisations is a non-governmental umbrella organisation for 41 consumer associations and has an integrated network with 16 consumer advice centers in the federal states. (EC 2009b)

4.6.4.2 France

The Consumer Safety Watchdog and the Health Watchdog are independent administrative authorities working on product safety issues. In addition, there are specialized agencies, like the French Agency for the Safety of Health Products and the French Food Safety Agency, working on consumer protection.

National consumer organisations include the Federal Union of Consumers and the Confederation for Consumer Affairs, Housing and Quality of Life. (EC 2009b)

4.6.4.3 EU

The European Consumer Centres Network (ECC-Net) is an EU wide network designed to help consumers in cross-border cases (ECC-Net 2009).

4.6.4.4 The United States

The Federal Trade Commission has the surveillance of product safety issues at the federal level and the States have a Department of Consumer Affairs. The Consumer Product Safety Commission is an independent agency working on product safety. A number of non-governmental organisations are also working on the issue. The U.S. Consumer Product Safety Commission (CPSC) is charged with protecting the public from unreasonable risks of serious injury or death from thousands of types of consumer products under the agency's jurisdiction. The CPSC is committed to protect consumers from products that pose fire, electrical, chemical, or mechanical hazard or can injure children. The CPSC's work to ensure the safety of consumer products, has contributed significantly the 30 percent decline in the rate of deaths and injuries associated with consumer products over the past 30 years.

Currently 13 states are included in the Interstate Mercury Education and Reduction Clearinghouse (IMERC). Seven states have adopted a legislation that requires companies selling mercury-added products to submit information to the Mercury–Added Products Database, a collaborative program of IMERC. The database is open to the public and it provides information on the amount and purpose of mercury in consumer products as well as identification of mercury-added products and their manufacturers. The authorities use the database to identify product categories posing high risks. An Interstate Chemicals Clearinghouse for sharing information on different products is currently under negotiation.

Source Ranking Database (SRD) developed by the US EPA is designed for risk-based ranking of over 12,000 potential indoor pollution sources by the hazardousness of the chemical and the use environment of the product. It is a tool to identify product or material categories or products containing certain chemicals. The database includes different consumer products, building materials and furnishings that contribute indoor air pollution. Product categories include, carpets, rugs, furniture, pharmaceutical preparations, detergents and cleaning agents, paints, cosmetics and personal care products, coatings, pesticides, wall coverings, , textile finishes and flooring. Chemicals in the database include phthalates, lead, tributyltin, adipates, and nonylphenols and nonylphenol ethoxylates, for example. (USEPA 2009b, Massey et al. 2008)

The U.S. Consumer Product Safety Commission (CPSC) has the responsibility to protect the public from unreasonable risks of serious injury or death from thousands of types of consumer products The CPSC's work to ensure the safety of consumer products - such as toys, cribs, power tools, cigarette lighters, and household chemicals – has been regarded to have contributed significantly to the 30 percent decline in the rate of deaths and injuries associated with consumer products over the past 30 years.

The Household Products Database contains information to consumers on over 5000 common household products and their health and safety aspects. The database is maintained under the US Department of Health and Human Services. (HHS, 2009).

4.6.4.5 Thailand

Thailand maintains a database of chemical safety (Platform on Chemicals Safety[18]).

[18] www.chemtrack.org

5 OVERVIEW OF LIKELY RELEASES FROM THE USE PHASE OF PRODUCTS

5.1 Release routes to the environment

Substances in products can be chemically bound to other material in the product thus resulting to negligible releases to the environment while those chemicals less tightly bound may be released even in normal use conditions.

Releases from the use phase of products end up to the environment in different routes, such as for example:

- in channelled and often abated air emissions from PRTR facilities
- through effluent from waste water treatment plants and from landfill leakage
- directly to the air, water, or soil
- indirectly through waste streams, e.g. through storm waters and municipal sludge
- indirectly through primarily indoor releases that are emitted outdoors through ventilation

5.2 Direct releases to the environment

Relatively, little is known of direct chemical releases to the environment from the use of products, while releases from regulated sources, such as industry, are rather well understood. For many products an increased use of a chemical in the production does not necessarily lead to increased releases, as the chemical is likely stay in the product during the use, or the leaks are minor. However, certain products are used in a way where it is likely that the same or even greater amounts of chemicals used in the product disperse from the product during use. An example is wood impregnation agents.

Direct releases to water occur when products are used in a way where possible releases are lead directly to water bodies without treatment at WWTPs. For instance, textiles (such as carpets and clothes) may be washed in natural waters and there may be direct releases from boat keels and fish farming nets to the water body (Figure 7).

Figure 7. Direct releases to air, soil and water from the use of products

Current understanding of chemical releases from the use of products is limited to few product-chemical combinations (Figure 8). Only a minor part of chemicals in commerce are currently regulated. Taking into account the lack of knowledge of products and their chemical content, the fast growing number of products

and chemicals in the society, and the complexity of their flows, as discussed above, makes it challenging to get a picture of the actual releases to the environment. Examples of direct releases to the environment from the use of products are provided in Volume 2 of the document.

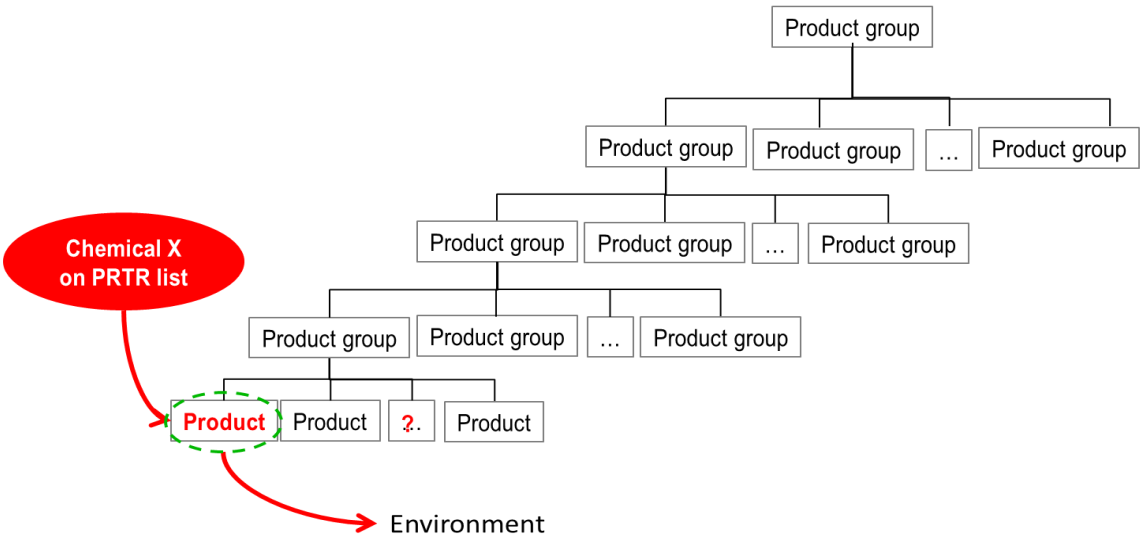

Figure 8. Current understanding of direct chemical releases to the environment is limited to few product-chemical combinations

5.3 Estimates of likely trends of product use related releases

Information on releases that are likely to occur during the use of certain products is presented under this chapter. Note that the compiled information cannot be regarded complete but only reflects information that was available during the preparation of the document.

Table 18 compiles available information on such end-products from which releases may occur and for which there exist methodology to quantify the releases. It is also indicated whether these releases are included in regular national inventories or inventories under international conventions.

Table 18. Examples of releases from the use phase of end-products

Product group	Examples of end-products	Substance	Effect in end-product	Releases to	RET exists	Regular inventory
Ammunition	Lead shots and bullets	As, Pb	Operational	Soil, water	x	(x)
	Tracer bullets (military)	HCBs	Operational	Soil, water	(x)	(x)
Biocides	Impregnated wood[19]	HCBs	Used as fungicide, pesticide	Air	x	(x)
		PCBs		Air	x	(x)
		PCNs		Air	x	(x)
		PFOA		Air	x	(x)
		HCBDs		Air	x	(x)
		As, Cr, Cu		Soil, Water	x	
	Seed, sorghum and crops protection	HCB, HCBD	Fungicider	Air	x	(x)
Building and construction	Pipes	Pb, Hg, Cu	Fungicide	Water	x	(x)
	Roofing and flashings	Pb	Material	Water	x	(x)
	Roofing	DEHP	Additive	Air, water, waste	(x)	

[19] Most of wood preservative active ingredients listed in column "Substance" are no longer permitted in the EU.

Product group	Examples of end-products	Substance	Effect in end-product	Releases to	RET exists	Regular inventory
		Cu	Material	Stormwater, soil		
	Facades, wall claddings, roofs	Cr, Ni	Steel structures	Soil, water	x	(x)
	Floor and wall material	NP/NPE, PCB, Pb, phthalates	Softener (phthalates)	Water	(x)	(x)
Cables and wires		PCBs, phthalates, DEHP	Plasticizer	Soil, water	(x)	(x)
Capacitors and transformers	Electrical distribution, lighting ballasts, motor start capacitors, transfprmers	PCBs	Dielectric fluids	Air	x	(x)
	Gyroscopes, transformers	HCBDs, PCNs	Hydraulic fluids	Air	x	(x)
Collector shoes		Pb	Inbound in material	Air, soil	x	(x)
Cleaning products	Laundry detergents, dry cleaning, car care products, paint and varnish removers	NPs/NPEs	Surfactant (tenside)	Water	(x)	(x)
	Cleaning agents, car waxes	PFOS	Surfactant	Air	x	(x)
	Floor polish		Surfactant	Air	x	(x)
	Dishwashing car care		As a rine-aid	Air	x	(x)
	Soap, cleaning agents	LAS, NH_3	Surfactants, effective alkaline	Water, air	(x)	(x)
	Cleaning agents	Phthalates, PFOA	Solvent, surfactant	Water	(x)	(x)
Dental care products	Dental amalgam	Hg	Dental fillings	Air, water	x	x
	Toothpaste	Triclosan	Antimicrobial agent	Water	(x)	(x)
Electrical equipment	Batteries, accumulators	Pb, Cd, Hg	Operational	Soil, water	x	(x)
	Switches and relays	Hg		Air	x	(x)
	TV sets, computer monitors	PCB, PBDE, Pb	Dielectric fluid in transformers	Air	x	(x)
	Solders, circuit boards	BFRs, Pb		Water	x	(x)
Fishing gear	Weights, keels	Pb	Operational	Water	x	(x)
Food handling	Treating fruit	HCBDs	Fumigant	Water	(x)	(x)
Furniture	Furniture foam and textiles, mattress	HBCD, PBDEs	Flame retardant	Air	x	(x)
		PFCs	Coating	Air	x	(x)
	Plastic furniture	Phthalates	Plasticizer	Water	(x)	(x)
		Pb, organotins	Stabilizers	Soil, water		
	Carpets	Formaldehyde	Finishes	Air	(x)	(x)
		Phthalates	Plasticizer			
		Organotins	Stabilizer	Water	(x)	(x)
		PBDEs	Flame retardants	Air		
		PFCs	Dirt repellent coating	Air		
		Pesticides	pesticide	Water	(x)	(x)
	Leather couches and armchairs	Cr	Tanning	Water		
		Dimethylfumarate	Anti-mould agent			
	Wooden furniture	Formaldehyde	Adhesive	Air		
		Pb, Hg	Paint	Air	x	(x)
Household appliances	Refrigerators, washing machines, air humidifiers	Silver	Antibacterial agent	Air	x	(x)
		NH_3	Refrigerant gas			

Product group	Examples of end-products	Substance	Effect in end-product	Releases to	RET exists	Regular inventory
	Table wear, glasswear	Pb	Coloring element	Soil		
Jointing, sealing filling and building material, lubricants, hydraulic and heat transfer	Hydraulic and heat transfer fluids, lubricants	PCBs, Pb	Flame retardant , plasticizer	Water		
	Insulating materials	BFRs	Flame retardants	Air		
		Formaldehyde		Air		
	Sealants and caulk	PCBs, Pb	Flame retardant , plasticizer	Air	x	(x)
	Building, automotive and industrial applications	SCCPs	Plasticiser			
Lighting	Fluorescent and energy saving lamps	Hg	Operational	Air, soil	x	(x)
Low-cost jewellery		Pb, Cd, Sb	Recycling	Soil	x	(x)
Measure& control equipment	Thermometers	Hg	Operational	Soil, water	(x)	(x)
Pyrotechnic	Pyrotechnic smokes (military)	HCBs	Operational	Air	x	(x)
	Firework	heavy metals	Pigment	Air	x	x
Photograph	Photographic applications	Silver, PFOS	Operational (Ag)	Water		
Radiation shielding	Computer glass and television screens	Pb	Operational	Air	(x)	(x)
Personal care products (including cosmetics, perfumes and hygiene products)	Sunscreens and lotions	EHMC, MBC, OC, BMDBM, BP3, siloxanes	UV filters, preservatives	Water	(x)	(x)
	Lotions, soaps and shampoos	Phthalates	Solvent, binding fragrances	Water	(x)	(x)
	Nail polish and hair sprays		Plasticizer	Water	(x)	(x)
	Soap, shampoo, hair dye, make up	NPs/NPEs	Surfactant	Water	(x)	(x)
	Shampoo	PFOS	Surfactant	Air	x	(x)
		Musk xylenes	Fragrances	Air	x	(x)
		Parabens	Preservatives			
Pharmaceuticals	Folklore medicine	Hg	Operational	Water	(x)	(x)
	Spermicides	NPs/NPEs	Operational	Water	(x)	(x)
Surface coatings (e.g. paint) and adhesives	Paint	Pb	Pigment	Air	x	(x)
	Ships, furniture, walls, ceiling	PCBs	Plasticizer, flame retardant	Water	x	
	Marine primer, road marking, fire-retardant paints	SCCPs	Plasticiser	Water, soil, Air	x	(x)
		Cr	Pigment	Air	x	(x)
	Latex paint	Hg	Additive	Air	x	(x)
Textiles	Sail and industrial protective clothing, lorry tarpaulings	SCCPs	Flame retardant	Water		
		Phthalates, PFOA	Surfactant	Water	(x)	(x)
	Terry towels, t-shirts, children's overalls	NPs/NPEs	Detergent (tenside)	Water	x	(x)
	Shoes	Particles	Material	Air	x	(x)
	Leather products, fabrics	DMF	Solvent, dye intermediate	Water	(x)	(x)
Toys	Plastic toys	Phthalates	Softening agent	Water	(x)	(x)
	Other toys	Pb	Paint, pigment	Water	(x)	(x)

(x) = research projects/certain countries/unpublished

The trend of releases from certain products being generally decreasing or increasing can be estimated on basis of restrictions already implemented on the use of certain products or chemicals in products or due to the fact that the use volume of certain products is increasing or decreasing. Estimates of such trends are presented in Tables 19 and 20. Information on product related legislation can be found in Chapter 3.

Table 19. Product groups where releases can be assumed to cease or decline due to restrictions

Product group	Chemical	Release trend	Affecting factors
Ammunition (shots)	Lead	Declining	Prohibitions on the use of Pb containing shots in wetland (e.g. in Finland). Restrictions on the use of Pb shots in shooting ranges (e.g. in Sweden and Denmark). A general national ban on shots containing lead in Norway.
Cable sheathing	Lead	Declining	Prohibitions on certain types of Pb cable sheaths (e.g. in Denmark)
Candle wicks	Lead	Almost ceased	Pb candle wicks banned in many countries, voluntary industry initiative to remove them from the EU market.
Capacitors and transformers	PCBs	Almost ceased	The use of PCBs has been banned in most of the countries. Old PCB containing devices may still be found.
Dental amalgam	Mercury	Declining	A general national ban for Hg containing products e.g. in Norway and Sweden
Electrical and electronic equipment	Lead	Slowly declining	Restrictions in the RoHS EU on the Pb content of electrical and electronic products.
	Mercury	Slowly declining	Ban for Hg containing products in the EU
Fishing gear	Lead	Declining	The use of Pb sinkers has been prohibited in certain areas in many countries (e.g. UK and Canada). Total ban on Pb containing fishing equipment in Denmark. Voluntary restrictions e.g. in Sweden.
Glasses and glazes	Lead	Slowly declining	Restrictions on the Pb content of glasses and glazes. A national ban on the import and marketing of Pb containing glazes, enamels and pigments on certain ceramics in Denmark.
Leaded gasoline	Lead	Almost ceased	Use of Pb in gasoline has been banned in most countries since the 1990's. Pb in gasoline is still allowed for certain uses in aviation and off-road vehicles.
Packaging	Lead	Some uses ceased, others declining	Use of Pb in solders of food cans, wine capsules, foil wrappers and security seals is prohibited in many countries.
	Bis-phenol-A	Slowly declining	Ban on the use of bisphenol-A in food containers, including baby bottles, in California. There is also a voluntary industry initiative to stop using bisphenol-A in baby bottles in the United States.
Lead containing paint	Lead	Almost ceased	The use of certain Pb compounds in paint (especially in residential paint) has been banned in many countries. These may still be used in developing countries. There are also restrictions for Pb content of paint.
	Mercury	Almost ceased	The use of Hg containing paint has been banned in many countries, still found in old applications.
	PCBs	Almost ceased	The use of PCB containing paint has been banned in most counties, but these may still be found e.g. in old buildings.
Pesticides	Lead	Declining	Pb containing pesticides have been banned, e.g. the use of $PbHAsO_4$ as insecticide (the USA)
PVC plastics	Lead	Declining	Voluntary industry initiative in the EU for ceasing the use of Pb as stabilizer in PVC plastics. Restrictions on Pb content of PVC plastics. A general national ban on Pb containing products, including plastic profiles, in Denmark.
Radiation shielding	Lead	Declining	Restrictions on the Pb content of cathode-ray tubes. The use of monitors with cathode-ray tubes is declining due to shifting into flat panel technology where less Pb is used compared to cathode ray tubes.
Roofing and flashings	Lead	Slowly declining	A general ban on certain Pb containing products, including the use of Pb flashings in Denmark. The use of Pb roofing and flashings continues in some countries and there are historical stocks.

Sealants and caulk	PCBs	Declining	PCB use in sealants and caulk has been banned in almost all countries, but they may still be found in many old buildings.
Textile and leather	Chromium(VI)	Slowly declining	There is a proposal for prohibiting the use of Cr^{6+} in certain leather products in Germany.
	PFOS	Declining	Use of PFOS in manufacturing of textile is prohibited in the EU; other PFCs may be used as alternatives. PFOS still used in some countries outside the EU.
	Dimethyl-fumarate	Slowly declining	The EU has banned the use of DMF as anti-mould agent.
	Azo-colourants	Declining	Restrictions on the use of certain azocolourants in textile.
Thermometers	Mercury	Declining	The use of Hg in products has been prohibited in many countries.
Toys	Phthalates	Slowly declining	Restrictions on the use of certain phthalates in children's products in the EU area. There is also a ban on the use of those phthalates in toys and child care articles in California.
	Lead	Slowly declining	Restrictions on the Pb content of toys in many countries. Imported toys may still have too high Pb content. There are also restrictions on the Pb content of children's jewellery, e.g. in California and Canada.
	Chromium(VI)	Slowly declining	There is a proposal for prohibiting the use of Cr^{6+} in leather toys in Germany.
Treated wood	CCA	Declining	Ban of the use of CCA for impregnating wood, e.g. in the EU.
Underwater weight	Lead	Slowly declining	Restrictions on the use of Pb in yacht keels.
Vehicles	Lead	Declining	Restrictions on the use of Pb in vehicle parts e.g. in the EU. Prohibition on the import and marketing of Pb containing brake linings in Denmark. Voluntary industry initiative to cease the use of Pb in wheel weights in the US.
Water pipes	Lead	Almost ceased	Restrictions on the use of Pb in water pipes, joints and solders in the EU and many countries. Prohibition on the import and marketing of Pb containing solder for the use in plumbing and sanitation in Denmark.
Weights	Lead	Slowly declining	Restrictions and prohibitions on Pb content of weights, e.g. Pb containing curtain weights are banned in Denmark.

Table 20. Product groups where releases are assumed to be increasing due to restrictions

Product group	Chemical	Trend description/affecting factors
Fluorescent lamps	Hg	The use of fluorescent "energy saving" lamps has increased.
Pharmaceuticals and personal care products	Different chemicals	The use of pharmaceuticals and personal care product has increased significantly and a large number of different chemicals are used in them.
Surface treated coating	Perfluorinated chemicals	Increased use of other fluorinated chemicals in stain, water and oil repellent coating of products after the phase out of PFOS (e.g. FTOH). Increased use of all-weather clothing.
Products from recycled material	Different chemicals	Increased use of recycled products may increase the product related releases.
Nanoproducts	Possible hazardous chemicals associated with nanomaterials	The use of nanomaterials is expected to increase.
Electrical and electronic products	Flame retardants	Due to restrictions on PBDEs, the use of other brominated flame retardants (e.g. TBBPA and HBCD) can increase. The amount of electronics has increased significantly in recent years.
Textile and leather products	Heavy metals, NMVOCs, POPs, Alcylphenols	Restrictions and bans on chemicals.

5.4 Product groups with likely releases (not included in other inventories)

Product groups that have relatively high releases during their use include building material, textile, furniture and electronic equipment. The tendency for high releases is based on the fact that while these products have a relatively long residence time, their use volumes also are high.

Product groups that have been identified as potential sources of releases during their use-phase are listed in Table 18 in alphabetic order. Note, that product groups or chemicals already included in other inventories are excluded from the list. It also needs to be kept in mind that the list cannot be exclusive due to the fact that little information is available on chemical contents of products and even less on concentrations released from the use phase of these products.

More detailed information of specific product groups, such as construction and building products, electrical and electronic products, furniture, nanoproducts, pharmaceuticals and personal care products, textiles, as well as toys and low-cost jewellery, is available in the annexes of this document, dedicated to each of these product groups. Detailed information of lead and nonylphenol releases related to product use is also provided in the Annexes.

6 GENERAL INTRODUCTION TO RELEASE PATTERNS

6.1 Relevant releases from the use of products

Information on chemical releases during the use of end-products is at the moment insufficient and in many cases of poor quality. Quantification of releases from product use is challenged due to the fact that there is not always sufficient information available on the chemical contents of products, neither on the release mechanisms of chemicals. In addition, the increased recycling of material to prepare new products further complicates this difficult task. From certain types of products that are used for very long periods, for instance buildings, chemicals may be released during decades, and because of this delay, information on chemicals used at the time of the construction work may have been lost.

Chemical releases from products are known to occur during the normal use of products through various mechanisms and environmental routes (Konsumentverket 2006, Jensen & Knudsen 2006, Kemi 2004a, 2009d, Peltonen 2005).

To determine if the release of a chemical from the use of a product is relevant for the environment, some background information is needed on the chemicals and their bioavailability, estimates on possible release rates with affecting factors (as explained under Chapter 3.2), as well as on the volume and use patterns of the products.

Based on this information conclusions can be drawn on whether releases of a chemical are significant enough to carry out quantification of the actual releases into the environment.

6.1.1 Chemicals and their bioavailability

Firstly, it is important to identify if chemicals with environmentally harmful properties that are likely to be released during the use of a product, and, if the chemicals are released in such concentrations and volumes that may cause harmful impacts on the environment. Information on where and how the products are used helps to assess the likelihood of releases during the use phase of the products.

Knowledge of the environmental bioavailability of a chemical can be used when determining the environmental significance of possible releases as this may vary greatly according to the form of dispersal. For example, the largest release can be in a form that has the lowest bioavailability and the smallest release can be in a form that has the highest bioavailability (Kemi 2004a).

Knowledge of the release recipients is needed to select the proper RET and to assess the shares of the release between the different environmental compartment (air, water, land/soil).

6.1.2 Factors affecting the volume of releases

To estimate the tendency of a chemical to be released during the use of a product, knowledge is needed on how the chemical is bound to the other material in the product. The releases are affected by the properties of both the chemical and product material as described below under Chapter 3.2 Release mechanisms.

The release concentration rates of a chemical vary depending on the environmental conditions and compartment to which chemicals are released as well as on the use patterns (intended/unintended) of the product, possible breakdown of the product and wearing as explained in Chapter 3.2.

Even if the release concentration of a chemical be low, the volume of products used may be large. The use volume is affected by the number of products as well as the frequency and duration of the use of the product.

6.1.3 When and where to expect releases – spatial and temporal distribution of releases

The technical service lives of products vary from several decades to short periods. Releases may occur first a long time after the products are taken into use, and be distributed evenly over the entire service life of the product or occur under a specific period during the use of the product.

Generally, releases from the use of a product are most likely to occur

- during the first use of a product
- when carrying out maintenance of the product
- due to wearing, exposure to heat or light or other ageing of the product

A product may be transferred between different countries in the world during its life-cycle, even the different parts of a single product can be manufactured in different countries. Products such as electronics, textiles, toys and jewellery, mercury thermometers and paints could be produced in China and India and marketed in Africa, Europe and United States. In addition, the disposal of products can take place in the country where it is used or the used products can be shipped to other countries where the product parts can be recycled and used in new items. Some chemicals remain in the product through the supply chain and end up in unexpected places. However, some product groups may present health or environmental problems due to inadequate waste handling and recycling practices, the lack of organized and controlled waste treatment and related legislation in developing countries. This is the case, for instance for electronic products. Due to the lack of information on the chemical content of the product, people in different countries (including manufacturers, repair personnel, consumers and recycling workers) can be exposed to hazardous chemicals in products (Agarwal 2009, Osibanjo 2009, Calabria 2007, McCarthy 2007, ChemicalWatch 2009c, Peytermann 2007).

When looking at releases from the use phase of end-products, it is important to pay attention to the fact that although the national surveillance of chemicals in products would be well organized, follow-up of chemicals in imported products may be challenging.

Also, the use place of the product may vary from stable (e.g. buildings), to mobile (e.g. packaging material) or be variable (e.g. use of consumer products).

Over time, releases can be transported away from their original release site. Certain chemicals from the use of products, for instance brominated flame retardants, can be long-range transported in the air for thousands of kilometres and chemicals in suspended particulate matter can end up in surface waters and soil far from their original site and be released to the environment from the particles only a longer period after being released from the product material matrix.

6.1.4 Chemicals that are present in the product intentionally

If the properties of certain chemicals are needed to give the product the desired properties, these products are designed to retain the presence of the chemicals during the service life. For instance, the functioning of batteries depends on certain heavy metals in the material, and therefore it is not likely to have high releases of these metals during the use of batteries. Another example on this type of products is refrigerant gases in

low-temperature apparatus. High releases from these types of products can be expected mainly during apparatus breakdowns and due to unmanaged waste handling.

6.1.5 *Chemicals that are present in the product unintentionally*

Substances with functions that are relevant only during the manufacturing phase of a product can be expected to result in higher emission rates if these substances remain present in the product after it has entered the market. During the manufacturing of products chemicals may be embedded in the product as unwanted remains, such as pesticide residues in textiles from the manufacturing phase of natural fibres, or solvent residues in fresh print products. The volume and quality of residual chemicals in the product vary and reliable information for a certain batch of a product can be retrieved accurately only by laboratory measurements.

6.1.6 *Chemicals intended to be released from the products*

The proper functioning of a product may require either that the chemicals are released in the desired manner, such as ink from ball point pens or colour cartridges, heavy metals during a fireworks display or propellant gas when using a fog horn, as well as different scent giving agents from, for instance, erasers or toys.

6.2 Release mechanisms and affecting factors

Release mechanisms and release rates of chemicals from the use-phase of end-products are affected both by the properties of the chemical present in the product and the product itself. At molecular level, the release volume depends on the concentration and properties of the chemical, the properties of the matrix to which it is bound, as well as on the type of bond between the chemical and the matrix.

Generally, low potential releases can be expected for a low release tendency chemical in a metal alloy. Examples of products from which high releases are likely are small molecular chemicals in a porous polymer material or chemicals with high vapour pressure.

A simplified scheme of the main factors affecting generation of releases from products during their use phase is provided in Figure 9.

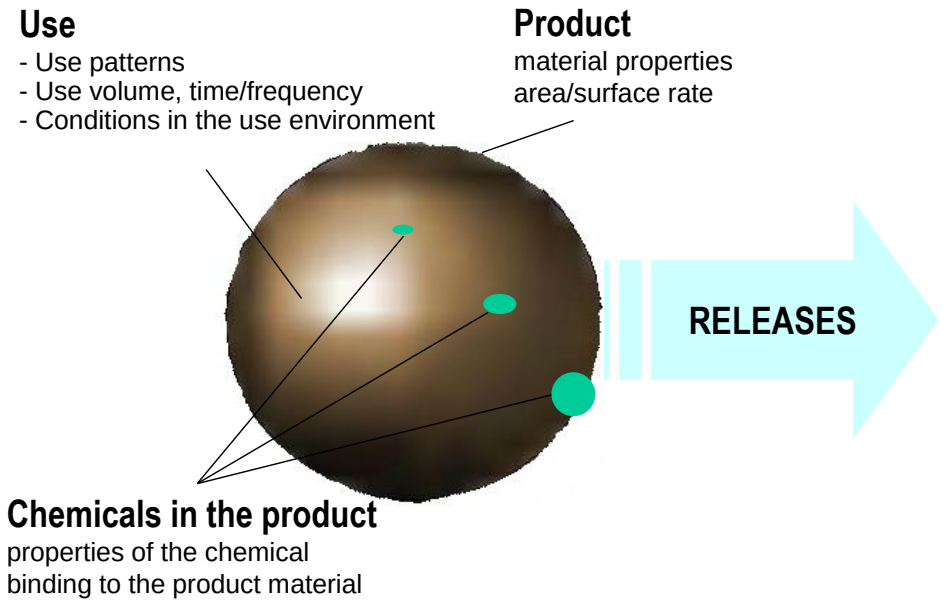

Figure 9. Simplified diagram on factors influencing releases of chemicals from the use of products

6.2.1 Factors that have an impact on the release tendency during the use of a product

6.2.1.1 Chemical and physical factors

Releases from the use of a product are impacted by chemical and physical factors related to both the product material and the substances in the product.

The structure of the product can be simple or it can be composed of a large number of materials, such as plastic, metal, glass, ceramics, textile or leather. Note that the properties of the product matrix can change due to aging or wearing of the product.

Chemical and physical factors of the product that impact releases during the use of the product include, for instance

- density and porosity of the material(s),
- product surface area/volume ratio,
- properties of the chemicals in the product, such as vapour pressure, water solubility, melting point, and
- bond type between the chemical and the matrix material

6.2.1.2 Environmental factors and use practices

The properties of the product matrix may change due to environmental conditions under which the product is used. For instance, exposure to heat under the sun or from a radiator increases the release rate of NMVOC compounds, as well as when electronic devices warm up during their use. Environmental conditions and sharp changes in them impact the generation of releases, for instance, ambient temperature

and pressure, humidity and exposure to factors causing wearing such as wind, light (ultraviolet radiation), abrasion or chemical reactions, including oxygenation and corrosion.

In cases where the product is used against its planned original use conditions, releases may be caused by conditions that were not taken into account in the design of the product. For instance, chemicals in a product which was not designed for wet conditions are likely to be dissolved when getting into contact with water.

6.2.2 Release mechanisms

6.2.2.1 Migration

Chemicals can be transported out of the product material by migration, for instance through volatilisation into the surrounding atmosphere, through dissolution into the surrounding water or through diffusion into a solid material. For instance, when the local equilibrium on the material surface layer is lowered due to evaporation of a volatile chemical into the atmosphere, the equilibrium concentration in the material is restored through migration. Liquid chemicals are usually more mobile than solid chemicals.

The migration velocity in a matrix is affected by the volatility or solubility of the chemical into the given matrix as well as by the diffusion velocity, which is affected by the concentration and mobility of the chemical.

Chemicals in adhesives or jointing material, such as PCB in sealants for building material, can migrate into the surrounding concrete and further into the environment, and chemicals from packaging are known to migrate into food. Some chemicals, for instance certain phthalates used as softeners in plastics and halogenated flame retardants, have higher tendency for migration than others (KemI 2004a).

6.2.2.2 Chemical reactions

The release potential of a chemical depends on how the chemical is bound to the product material matrix. The setting-strength of the chemical depends on the properties of both the chemical and the material.

In the manufacturing process of a product the purpose is to restrict possible releases by selecting chemicals and materials of low vapour pressure and water solubility to ensure that the chemicals that are needed to support the properties of the product remain there till the end of the life cycle. If the material is not intended to be exposed to water, e.g. certain colorants in paper, there may also be water-soluble additives present.

Substances that are chemically bound in the matrix of the product material can be expected to remain in the product until the disposal phase of the product, unless physical wear of the product occurs. It is known that chemical reactions leading to releases are usually initiated by physical wearing or abrasion of the product material.

Chemical reactions may take place with substances that have been present in the product material from the start, or between substances that have been formed in degradation processes and between substances that have migrated to the material over time (e.g. water, oxygen). For example, lead oxide is formed on the surface of metallic lead (such as lead flashings on chimneys and lead shot) due to oxygenation processes. Isocyanate releases are generated through heating of polyurethane foam plastic (e.g. by ironing). 2-ethylhexanol can be released to air from flooring material when the adhesive between the carpet and concrete is broken down by reaction between the adhesive chemicals and moisture. (KemI 2004a).

Chemicals used as additives in the product have more tendencies to be released than those that are chemically bound to the material. Examples of additives are colouring agents, biocides, flame retardants, softeners, antistatic substances, blowing agents. Releases of these chemicals depend on the properties of the matrix and the chemical (e.g. the size of the molecule, solubility in the matrix, vapour pressure and water solubility) as well as on the manner of use of the product.

6.2.3 Mechanical wear

Chemicals can be an integral part of the material of the product or bound in the cover, for instance in the surface treatment material, or in the binding material, such as glue. The size of the chemical molecule also has an impact: smaller molecules can move around the material by diffusion, e.g. plasticizers, flame retardants and biological agents.

Mechanical processing, abrasion, wear or break down of the material causes releases in particle form. Particle releases differ from molecular releases because the physical effects of the particles may override the chemical effects as they may stay inside the particles and their impact to the surrounding environment will be thus delayed (KemI 2004a).

7 GENERAL INTRODUCTION TO RELEASE ESTIMATION TECHNIQUES

7.1 Principles in estimation of releases from products

An inventory of a chemical from the use-phase of end-products should cover all relevant releases of the given chemical during the period of the actual use of the products.

7.1.1 Identify all relevant products

The total releases of a chemical may consist of releases from the use of several products as shown in Figure 10. The inventory of a chemical should identify all products with relevant releases of the given chemical from the different product groups and provide estimates of releases to air, water and soil.

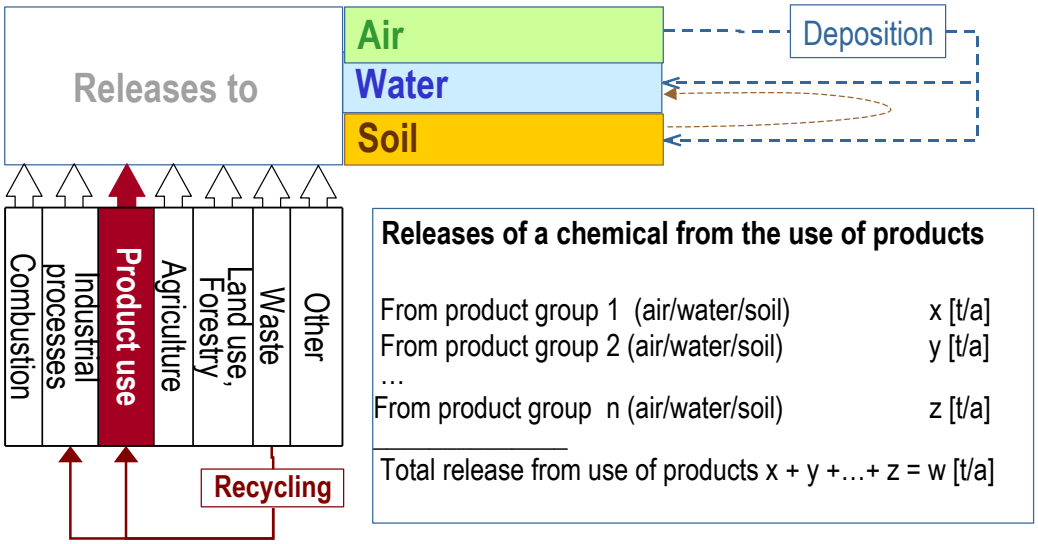

Figure 10. Total releases of a chemical to the environment from the use of end-products

7.1.2 Avoid double-counting

To quantify releases related to the use phase of end-products, it is essential to identify the period in the life-cycle of a product, between the point of time the product has left the manufacturing process (which is generally already covered by regular reporting to PRTRs) and the point of time when the product enters waste treatment (which is generally also covered by PRTRs), to prevent double-counting of releases.

In some cases, potential releases from the product use may already be covered in the inventory for the agriculture sector, as for instance, the use of pesticides might be allocated there. Other examples are releases from tire and brake wear, which may already be accounted for under the inventory of transport releases, and combustion of fuels allocated under the energy sector inventory. Thus only releases that are generated during the actual use of the product should be considered.

7.1.3 Releases from waste not to be included

Attention needs to be paid to the fact, that in many countries, where organized waste management does not yet take place, releases from the use of products may be understood to cover also releases from the disposal

of products. The reason for summing up releases from use phase and waste disposal phase is thus related to deficiency in the local waste management system and the related legislation. It should, however, be kept in mind that releases from discarded products cannot be reported under the product use category in PRTRs.

Releases from discarded products should be estimated separately from releases from the use of products, and reported under the waste category in PRTRs, either as diffuse releases or as point source releases from landfills, wastewater treatment plants and waste incineration plants.

7.2 Issues to consider when selecting products into the inventory

When selecting products to be included into the inventory, the following issues need to be considered:

- Are the products used in your country?
- Do the chemicals in the products have environmentally harmful properties?
- Where and how are the products used?
- Is it possible that the harmful chemicals are released to the environment in your country? Is it possible that the chemicals are released during the use of the product or would these chemicals be released only during the manufacturing or waste handling phase of the life cycle of the product?
- Are the releases in already included into the current inventory and reporting systems?

7.3 Quantification of releases

7.3.1 Basic equation

The general equation (Equation 1) for quantification of releases can be applied also to releases from the use of products. For the calculation, an estimate of product use related release rate (emission factor)[20] is needed. The emission factor needs to be estimated separately for the different environmental compartments (e.g. air, water and soil). Statistical data (activity data)[21], which fits the release rate needs to be available to enable calculation of the releases.

$$E = Ef \cdot A$$

E = Release of chemical

Ef = Emission factor

A = Activity data

The equation can be modified according to data that is available for the quantification of releases. Activity data can be composed of various factors. For instance, the number of products used and the content of the

[20] i.e. release concentration levels, e.g. “mg of a chemical/kg of product consumed” or “% of the chemical content of in the products consumed”

[21] Activity data can be, for instance, data on use volume of a product (number of products and their use volumes), or production volume of a product / content of the chemical to be quantified in the products)

given chemical in the product establish together sufficient activity data to be used with an emission factor that represent the release rate of the chemical from the product. In case emission factors are not given separately to releases to air, water and soil, factors representing the distribution of releases between the different environmental compartments (air, water, soil) can be added to the equation.

7.3.2 Selection of an emission factor

When selecting RETs and the emission factor for calculation of releases from the use phase of products, it is advisable to compile information on the chemical content of the given products used in your country. This information is then compared to the assumptions in the RETs.

Attention needs to be paid to the following issues:

- does the RET and the emission factor represent the chemical composition of products used in your country
- does the emission factor represent the general use patterns of the product in your country

7.3.3 Selection of activity data

Activity data that corresponds the rate of activity indicated by the selected emission factor needs to be available for the quantification of releases.

For example, if the emission factor is related to the share of the chemical to be evaporated from the total content of that chemical in the product, the emission factor may be given as mass unit of the evaporated rate of the chemical per mass unit of the total chemical content. Thus the activity data needs to represent the estimated total chemical content in all corresponding products in your country. The preparation of suitable activity data needs to involve an inventory of the volume of the given products in your country as well as data on the content of the given chemical in these products.

An alternative may be to obtain directly the amount of the given chemical in all products. This type of information may be available in product registers. However, in some cases it may be possible to receive the total volume of an effective chemical included in all products but not the content of the chemical in different products.

7.3.4 **Quantifying releases over the years**

When quantifying releases from the use of products over different years, the following information on the release patterns is useful:

1. In cases where the release rate can be considered relatively even over time it can be assumed that the release from the use phase of these products are distributed evenly over the entire service life of the product (examples: particles and heavy metals from vehicle tyre wear during driving and some biocides from the use of treated wood). The annual releases can then be calculated by dividing the total chemical releases by the number of years.

2. In cases where the releases are not high and are gradually ceasing over the years it can be assumed that releases occur during a specific period. The number of years under which the releases are included into the inventory needs to be determined case by case for each product/chemical combination.

3. In cases where the main part of releases from the use of the product is generated during the first use of the product, it can be assumed that all releases occur during the year when the product is sold to the market. For instance, volatile organic compound releases from paint application can be assumed to occur in the year when the paint is sold to the consumer.

The third method in the list above is the simplest one and is often applied to all cases.

It is possible that accumulation occurs if the substance has a residence time longer than one year and the total number of products in use is high. The cumulative quantity of the chemical can be estimated by multiplying the residence time (e.g. number of years the product has been in use) of the chemical with the quantity added in a year. For this calculation, information of the historical volumes of the use of a chemical in a product, as well as the consumption of the products, is needed.

If the product has already been used for a longer period of time at a relatively constant consumption, it can be expected that the maximum cumulative quantity of the chemical already has been reached. Chemicals that are not very persistent can be assumed to degrade over time. The degradation rate depends on the chemical. To simplify calculations, it can be assumed that when a steady state has been reached with a relatively constant annual consumption, the annual quantity added equals the removal of the chemical.

7.4 Overview of existing RETs for products

Release estimation techniques presented in Tables 21 - 26 are based on information provided by the OECD countries as well as from the literature. Information provided in these tables is not comprehensive and it is likely that additional RETs exist that were either not identified during the project or that are not yet published.

Release estimation techniques are presented in the tables as follows:

- RETs for heavy metals: Mercury (Hg) in Table 21 and for chromium (Cr), copper (Cu) and arsenic (As) in Table 22
- RETs for lead (Pb) in Table 23
- RETs for nonylphenols (NP) and nonylphenol ethoxylates (NPE) in Table 24
- RETs for brominated flame retardants (BRF) in Table 25
- RETs for persistent organic compounds (POPs) in Table 26

Table 21. Examples of RETs available to quantify Hg releases from products

Product	Release	Equation	Emission factor	Reference
Electrical equipment containing mercury	Air	$E = Ef \cdot A$ E = Hg emission (t) Ef = Emission factor (t) A = Population in the country	0.0019 t/population of 10^6 (Western Europe)	EMEP (2000b) ref. WS Atkins (1997)
	Air		0.0003t/ population of 10^6 (Eastern Europe)	

	Air Annual emissions due to breaking or leakage within one year from consumption.	$E = Ef \cdot Df \cdot S \cdot A$ E = Hg emission(mass unit) Ef = Emission factor for all groups 5% Df = Distribution factor for a given group: batteries 1%, measuring and control equipment 5%, electrical equipment 1% light sources 5% S = Share during the first year 5% during the next 10 years 0.05% annually A = Mass of total Hg in all Hg containing products i	5% distribution factors for product groups	Kindbom & Munthe (2007)
	Air	$E = Ef \cdot A$ E = Hg release(mass unit) Ef = Emission factor A = Mass of mercury in products	1.5%	Cain et al. (2007)
	Water		1%	
	Thermometers Air	$E = Ef \cdot A$ E = Hg release (mass unit) Ef = Emission factor A = Mass of Hg in products	10%	Cain et al. (2007
	Thermometers Water		1%	
	Air Hg containing instruments	$E = Ef \cdot A$ E = Hg emission (kg) Ef = Emission factor A = Mass of Hg in products	0.35 kg/kg (35 %)	SFT (2004)
Measurement and control equipment	Air	$E = Ef \cdot A$ E = Hg emission (t) Ef = Emission factor (t) A = Population in the country	0.0044 t/population of 10^6 (Western Europe)	EMEP (2000b) ref. WS Atkins (1997)
	Air		0.0013 t/population of 10^6 (Eastern Europe)	
	Air	$E = Ef \cdot A$ E = Hg release (mass unit) Ef = Emission factor A = Mass of Hg in products	1.5% (except thermometer)	Cain et al. (2007)
	Water		1% (except thermometers)	
	Air Annual emissions due to breaking or leakage within one year from consumption.	$E = Ef \cdot Df \cdot S \cdot A$ E = Hg emission (mass unit) Ef = Emission factor for all groups 5% Df = Distribution factor for a given group: batteries 1%, measuring&control, equipment 5%, electrical equipment 1% , light sources 5% S = Share during the first year 5% during the next 10 years 0.05% annually A = Mass of total Hg in all Hg containing products	5% distribution factors for product groups	Kindbom & Munthe (2007)
Batteries	Air, leakage	$E = Ef \cdot A$ E = Hg emission (t) Ef = Emission factor (t) A = Population in the country	0.0002t/ population of 10^6 (Western Europe)	EMEP (2000b) ref. WS Atkins (1997)
	Air, leakage		0.00004t/population of 10^6 (Eastern Europe)	

	Air Annual emissions due to breaking or leakage within one year from consumption.	$E = Ef \cdot Df \cdot S \cdot A$ E = Hg emission (mass unit) Ef = Emission factor for all groups 5% Df = Distribution factor for a given group: batteries 1%, measuring & control equipment, 5% electrical equipment 1% , light sources 5% S = Share during the first year 5% during the next 10 years 0.05% annually A = Mass of total Hg in all Hg containing products	5% distribution factors for product groups	Kindbom & Munthe (2007)
Light sources	Air as HgO when a warm lamp is broken	$E = Ef \cdot A$ E = Hg emission (t) Ef = Emission factor (t) A = Population in the country	0.0005 population of 10^6 (Western Europe)	EMEP (2000b) ref. WS Atkins (1997)
	Air		0.0003 population of 10^6 (Eastern Europe)	
	Air	$E = Ef \cdot A$ E = Hg release (mass unit) Ef = Emission factor A = Mass of Hg in products	10%	Cain et al. (2007)
	Water		1%	
	Air, as HgO when a warm lamp is broken. Annual emissions due to breaking or leakage within one year from consumption.	$E = Ef \cdot Df \cdot S \cdot A$ E = Hg emission (mass unit) Ef = Emission factor for all groups 5% Df = Distribution factor for a given group: batteries 1%, measuring & control equipment 5% electrical equipment 1% , light sources 5% S = Share during the 1st yr 5% during the next 10 years 0.05% annually A = Mass of total Hg in all Hg containing products	5% distribution factors for product groups	Kindbom & Munthe (2007)
	Air	$E = Ef \cdot A$ E = Hg release (kg) Ef = Emission factor A = Mass of Hg in products	0.21 kg/kg (21 %)	SFT (2004)
	Water		0.06 kg/kg (6 %)	
	Soil		0.04 kg/kg (4 %)	
Dental amalgam	Water	$E = Ef \cdot A$ E=Hg emission (kg) Ef= kg emitted per person A= number of persons	60 µg/24 h and person	Skare&Engqvist 1994 Sörme & Lagerkvist 2002

Table 22. Release estimation techniques to quantify Cr, Cu and As releases from products

Product	Release	Equation	Emission factor	Reference
As, Cr and Cu from wooden toys	Treated wooden play structures to soil	$E = Ef \cdot A$ E = heavy metal emission (kg) Ef = emission factor (kg/kg) A = amount of substance used (proportion in CCA) (kg) Distribution between air, water and soil: 0 % to air 0 % to water 30 % to soil during 30-50 years (1 % per year for 30 years).	0.01 kg/kg (1 %)	SFT (2004)
As, Cr and Cu from wooden furniture	Soil		0.01 kg/kg (1 %)	SFT (2004)
Cr, Fe, Zn, Pb from plastic bags	Soil	E = A * K * EF where E = Release of a metal to water (kg/year) A = Activity data K = Percentage for releases to water, default value 0.598 EF = concentration of a chemical present in one kilogramme of shopping bags [kg/kg]; Activity data needed for the calculation A = N * M where M = Mass for one unit (kg) default for common shopping bags: LDPE bag: 15-26 g/bag, HDPE bag 6 g bag (SFT, 2008). N = unit count (number of bags left in the nature, N), see calculation of N above.	0.0115 kg/kg for Cr, Fe, Zn and Pb in pigments	Munther J in Saarinen et al (2014)
Cd, Cu, Pb, Zn from vehicle brake wear	Air	E = EF * T where E = releases (kg) EF= emission factor (mkg/km) T = annually driven kilometres Diverse EFs, see Table 8 of Chapter 8 under “Part A Recommended RETs for Selected Products” in Volume 2 of the document, where also a more detailed methodology is available.		Sörme L in Saarinen et al (2014)
Cd, Cu, Pb and Zn from vehicle tyre wear	Air	$ME = \sum_{v} \left[\frac{P \times C \times TV \times F}{1000} \right]$ where ME = heavy metal emission P = tyre wear C = mean metal concentration in tyres TV = traffic work (km/year) F = proportion driven with each type of vehicle and brand expressed as annual sales figures *Calculation of tyre wear* P = EF * TV where		Sörme L in Saarinen et al (2014)

		P = emissions of particulate matter EF = emission factor TV = annually driven kilometres Diverse EFs, see Table 10 of Chapter 9 under "Part A Recommended RETs for Selected Products" in Volume 2 of the document		
CCA-treated wooden structures	Soil	$E = Ef \cdot A$ E = heavy metal emission (kg) Ef = emission factor (kg/kg) A = amount of substance used (proportion in CCA) (kg)	ca. 0.01 kg/kg (1 %)	Braunschweiler et al. 1996, Shibata et al. (2007), Ansen et al. (2000); SFT (2004)
Cr from paint, varnish etc.	Soil	$E = Ef \cdot A$ E = heavy metal emission (kg) Ef = emission factor (kg/kg), 100 kg/kg A = mass of Cu in paint/fungicides (kg/t)*use of pesticide (t)	0.1 kg/kg (10 %)	SFT (2004)
Cu and TBT from antifouling paint (underseal treatment)	Water	E = A * EF * K where E = copper releases from the use of antifouling A = activity data EF= emission factor for copper emissions to (air, water or soil) Ew = release to water Es = release to soil	Water: 0.81 kg/kg (81 %)	SFT (2004) and Lahti M. in (Saarinen et al 2014)
	Soil		Direct release to soil: 19 % Hazardous waste from shipyards to proper treatment 9 %	
Cu from fish farming nets	Water	E = A * EF * K where E = copper releases from the use of antifouling A = copper content of antifouling EF= emission factor for copper releases to (air, water or soil) Ew = release to water	Direct release to water 100% if no collection of hazardous waste and 85% if net washing sites deliver hazardous waste to proper treatment	Lahti M. in Saarinen et al (2014)
Cu from fungicide	Soil		100 kg/kg (100 %)	SFT (2004, 2009b)
Cu roofs	Storm water and soil	$E = Ef \cdot A$ E= Cu emission (g) Ef= g emitted per square meter A=number of square meters	2.0 g/m^2 per year	He et al, 2001 Sörme & Lagerkvist, 2002

Cu pipes and taps	Wastewater	$E = Ef \cdot A$ E= Cu emission (g) Ef= g Cu emitted per person A=number of persons	1,9 g/person and year	Sörme et al., 2001. Sörme & Lagerkvist, 2002
Hg from various products	Air, water	E = EF* P where E = emission of Hg to air (kg) EF = emission factor (see below) P = population Batteries (air) 0.0017 / mill. inhabitants Electrical equipment (air) 0.048 t/mill inhabitants Electrical equipment (water) 0.0027 t/mill inhabitants Light sources (air) 0.004 t/mill inhabitants Light sources (water) 0.000044 t/mill inhabitants Measurement equipment (air) 0.021 t/mill inhabitants Measurement equipment (water) 0.00017 t/mill inhabitants		Sörme L in Saarinen et al (2014)

Table 23. Release estimation techniques to quantify Pb releases from products

Product	Release	Equation	Emission factor	Reference
Lead sheet	Water, soil	$E = Ef \cdot A$ E = Pb emission (kg) E_f = emission factor (g/m^2) or (%) A = area of Pb sheet (m^2) or amount of Pb in the sheet (kg)	5 g/m^2 (corrosion rate), to water 0,008 %, to soil 0,006 %	Tukker et al. (2001)
	Roofing, water, soil	$E = Ef \cdot Df \cdot A$ E = Pb emission (in solid form) (kg) Df = division factor: Df-Soil: 0.3 residential buildings 0.8 utility buildings; Df-Water 0.15 residential buildings 0.2 utility buildings Ef = run-off factor for Pb (g/m^2) A = exposed area of Pb roofing (m^2)	5 g/m^2 (run-off rate),	Wilson (2003), Van Hyfte & Callebaut (2007)
	Flashings, water, soil		0.88 g/m^2 (run-off rate),	
Lead pipes	Waste-water	$E = Ef \cdot A$ E = Pb emission (mg) Ef = emission factor (mg/capita) A = capita in a given year	1.014 mg/capita	Tukker et al. (2001)
Paint	Soil	$E = Ef \cdot A$ E = Pb emission (kg) Ef = emission factor (kg/kg) A = population in a given year	0.1 kg/kg (10 %)	SFT (2004)

Table 24. Release estimation techniques to quantify nonylphenol (NP) and nonylphenol ethoxylate (NPE) releases from products

Product	Release	Equation	Emission factor	Reference
Plastic toys Plastic packages	Storm water	$E = Ef \cdot A$ E = NP release (kg) Ef = emission factor A = used amount of plastics annually (m^2) The weight of PVC plastics can be assumed to be 2000 g for an area of 1 m^2 with a thickness of 1.5 mm, no distinction between product groups.	$2.78*10^{-12}$ kg/m^2 (hard plastics) $4.64*10^{-12}$ kg/m^2 (soft plastics)	Hansson et al. (2008)
Concrete	Storm water	$E = Ef \cdot A$ E = NP release (kg) Ef= emission factor, mg/m^2 A = surface of construction (m^2)	0.2 mg/m^2	Hansson et al. (2008)
Wall and floor coverings	Storm water	$E = Ef \cdot A$ E = NP release (kg) Ef = emission factor (kg/m^2) A = used amount of plastics annually (m^2) The weight of PVC plastics can be assumed to be 2000 g for an area of 1 m^2 with a thickness of 1.5 mm, no distinction between product groups.	$2.78*10^{-12}$ kg/m^2 (hard plastics) $4.64*10^{-12}$ kg/m^2 (soft plastics)	Hansson et al. (2008)
Paints and varnishes	Wastewater	$E = Ef \cdot A$ E = NP release (kg) Ef = emission factor (kg/kg) A = chemical content in paints (t/a)	0.005 kg/kg (0.5 %)	Hansson et al. (2008)
Adhesives	Wastewater		0.01 kg/kg (1 %)	Hansson et al. (2008)
Plastic toys	Water	$E = Ef \cdot A$ E = NP release (kg) Ef = emission factor (kg/m^2) A = used amount of plastics annually (m^2) The weight of PVC plastics can be assumed to be 2000 g for an area of 1 m^2 with a thickness of 1.5 mm, no distinction between product groups.	$2.78*10^{-12}$ kg/m^2 (hard plastics) $4.64*10^{-12}$ kg/m^2 (soft plastics)	Hansson et al. (2008)
Additives in pesticides	Soil	$E = Ef \cdot A$ E = NP release (kg) Ef = emission factor (kg/kg) A = used amount of NPEs in pesticides (import + manufacturing – export) (kg)	0.85 kg/kg (85 %)	Hansson et al. (2008)
	Surface waters		0.1 kg/kg (10 %)	
	Air		0.05 kg/kg (5 %)	

Pharmaceuticals	APIs to wastewater	$E = D * F_e * F_p * C_{WWTP} * F_f$ E = API release (mass unit) D = Daily dose consumed per inhabitant (mg $inh^{-1}d^{-1}$) F_e = Fraction of parent compound excreted after metabolism (%) F_p = Percentage of market penetration (%) (proportion of population daily treated with the specific drug substance; default 0.01) C_{WWTP} = Capacity of a local WWTP (population equivalent) F_f = Fraction of residue in effluent (%)		EMEA (2006)
	NPEs to soil	$E = Ef \cdot A$ E = NPE release (kg) Ef = emission factor (kg/kg) A = amount of NPEs in the medicine (import + manufacturing – export) (kg)	0.85 kg/kg (85 %)	Hansson et al. (2008)
	NPEs to water		0.1 kg/kg (10 %)	
	NPEs to air (veterinary medicinal products)		0.05 kg/kg (5 %)	
Detergents and auxiliaries in textile &leather products	Water	$E = Ef \cdot A$ E = NP release (kg) Ef = emission factor (kg/t) A = import – export of textiles (tonnes)	0,250 kg/t	Hansson et al. (2008)
Cleaning products, cosmetics and hygiene products	Wastewater	$E = Ef \cdot A$ E = NPE release (kg) Ef = emission factor (kg/kg) A = amount of NPE (import + manufacturing – export of cleaning agents) (kg)	0.9 kg/kg (90 %)	Hansson et al. (2008)
	Air		0.0025 kg/kg (0.25 %)	
Car care products, detergents, cleaners	Water	$E = Ef \cdot A$ E = NP release (kg) Ef = emission factor (kg/kg) A = used amount of product	0.2 kg/kg (20 %) not connected to WWTPs; 0.28 kg/kg (28 %) connected to WWTPs	SFT (2004)
	Soil		0.136 kg/kg (13.6 %)	
Textiles	Wastewater	$E = Ef \cdot A$ E= Emission (kg) EF = Emission factor (g/person) A=number of persons	0.7-1.6 g NP_{eq} /person and year	Månsson et al, 2008
Cleaning agents	Wastewater	$E = Ef \cdot A$ E= Emission (kg) EF = Emission factor (g/person) A=number of persons	0.1 g NP_{eq} /person and year	Månsson et al, 2008

Table 25. Release estimation techniques to quantify releases of BFRs from products

Product	Release	Equation	Emission factor	Reference
Furniture foam and textiles	Air	$E = Ef \cdot A$ E = BFR release (kg) E_f = emission factor (kg/kg) A = amount of BFR in the product (kg)	0.05 %	SFT (2004, 2009)
	Water		0.05 % (with WWTP) 0.7 % (without WWTP)	
Insulating material in construction work	Air		0.05 %	SFT (2004, 2009)
	Water		0.05 % (indoor use) 0.7 % (outdoor use)	
Flame retardants in textiles	Air		0.05 %	SFT (2004, 2009)
	Water		0.05 % (indoor use) 0.7 % (outdoor use)	
Enclosures and monitors	Air		0.05 %	SFT (2004, 2009)
	Water		0.05 % (indoor use) 0.7 % (outdoor use)	

Table 26. Release estimation techniques to quantify releases of POPs and NMVOCs from products

End-product group	Release	Equation	Emission factor	Reference
Cationic surfactants, DTDMAC, DSDMAC, DHTDMAC from car care products (washing agents, wax etc.) and other products	Water	$E = Ef \cdot A$ E = Surfactant emission (kg) Ef = Emission factor (kg/kg) A = amount of the specific cationic surfactant in the product (kg)	0.2 kg/kg (20%)	SFT (2004)
	Soil		0.4 kg/kg (40%)	
DEHP from cables in the soil	Soil	$E = Ef \cdot A$ E = DEHP emission (mass unit) Ef = Emission factor (%) A = DEHP content in the cable	1.2%/a	Sandström (2002)
DEHP from PVC flooring	Air	E = A1 * F * EF * 24 * 365 where E = emission indoors [kg/year] A = area of PVC flooring [m2] F = fraction of PVC flooring plasticized with DEHP EF= emission factor [µg m^{-2} h^{-1}]	3.11 µg m-2 h^{-1} DEHP 74% of the total DEHP emission (4.2 µg m^{-2} h^{-1}) goes to air. The fraction of PVC flooring plasticized with DEHP in the year of calculation = 70%	Westerlund J in Saarinen et al (2014)
	Water		0.37 µg m^{-2} h^{-1} DEHP 8.8% of the total DEHP release (4.2 µg m^{-2} h^{-1}) goes to wastewater. The fraction of PVC flooring plasticized with DEHP in the year of calculation = 70%	

	landfill/ incineration		0.17 µg m-2 h-1 DEHP 4.1% of the total DEHP emission (4.2 µg $m^{-2\ h-1}$) The fraction of PVC flooring plasticized with DEHP in the year of calculation = 70%	
DEHP from roofing	Water and soil		0.985 g/m^2/a (general) 2,31 g/m^2/a (gravelled roofs)	Sandström (2002)
DEHP from vinyl products	Air (indoor)	$E = Ef \cdot A$ E = DEHP emission (g) Ef = Emission (factor g/m^2) A = surface area of the product	9.5 mg/m^2/a	Sandström (2002)
Detergents from soaps	Waste-water	$E = \frac{A \cdot 10^6}{Y \cdot 365}$ E = Detergent discharge (g) A = Volume of applied detergent (t/a) Y = Population of area or number of people consuming the detergent	The maximum authorised concentration in finished cosmetic products is given in EU Directive 76/768/ EEC concerning cosmetic products Annex III Part 1 (List of substances which cosmetic products must not contain except subject to the restrictions and conditions lay down). Due to the high number of chemicals listed in the Annex only reference to the document is provided here.	EC (2003b)
Ethanol from car care products	Air	E = U where U = Use of ethanol in care products (kg)	100% of ethanol in the product	Sörme L in Saarinen et al (2014)
HCB from fungicides, herbicides and algaecides	Air	$E = Ef \cdot A$ E = HCB emission (mass unit) Ef = Emission factor (%) A = HCB content in biocides	40% of HCB volume applied during field use	EMEP (2005).
		$E = Ef \cdot A$ E = HCB emission (mg) Ef = Emission factor (mg/ha) A = area of land treated (ha)	50-150 mg/ha (total arable land and permanent crop) per year	EMEP (2005).
		$E = Ef \cdot A$ E = HCB emission (mg) Ef = Emission factor (mg/ha) A = area of land treated (ha)	100 mg/ha (arable land and permanent crops)	EMEP (2005).
		$E = Ef \cdot A$ E = HCB emission (t) Ef = Emission factor (mg/ha) A = volume of HCB field application (t)	0.40 t/t (field application) 0.20 t/t (greenhouses)	EMEP (2005).

		$E = Ef \cdot A$ E = HCB emission (t) Ef = Emission factor (mg/ha) A = volume of HCB field application (t)	0.50 t/t (<0.1% of total fungicide consumption)	EMEP (2005).
HCBD from chlorinated solvents	Air	$E = Ef \cdot A$ E = HCBD emission (mass unit) Ef = Emission factor (mass/mass) A = amount of HCBD in the solvent	3 ng/ml	ENGO (Tilman 2003)
	Air		0,2 kg/t	SYKE 2008
PAH-4 (e.g. benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene[22]) from bitumen roofing products	Air	E = (A * K * C)*10-6 where E = emission of a PAH compound/s to air (kg/year) A = annually used amount of bitumen in hot-applied bitumen roofing (tonnes/year) K = loss of bitumen on heating of bitumen in hot-applied roofing (0.105 %) C = concentration of PAH compound/s in bitumen fume (mg/kg)	0.0126 mg/kg	Forsberg T (2013) in Saarinen et al (2014)
	Soil	E = A * EF where E = release of PAH-4 to air [kg/year] A = annual area of road paving with asphalt [tonnes/year] EF = annual leaching of PAH-4 compounds to soil [mg/kg]	0.1565 mg/m2	Forsberg T (2013) in Saarinen et al (2014)
PAHs from treated wood	Air	$E = Ef \cdot A$ E = PAH release (kg) Ef = Emission factor (kg/kg) A = amount of PAH in product (kg)	0.01 kg/kg (1%)	SFT (2004)
	Soil		0.02 kg/kg (2%)	
PCBs from transformers	Leaks	$E = Ef \cdot A$ E = PCB emission (kg) Ef = Emission factor (kg/t) A = Activity data	Default volume of leaks 0.06 kg/t Emission factor to air: 0	EMEP (2000a) ref. TNO (1995)
			Default volume of leaks 0.3 kg/t Emission factor to air:0	EMEP (2000a) ref. USEPA (1997)

[22] these compounds are summed up as the PAH-4 of PRTR reporting

			Default volume of leaks 0.3 kg/t Emission factor to air 0.06 kg/t	EMEP (2000a) ref. Belarusian report (2000)
			Default volume of leaks 0.006-0.5 g/capita/year Recommended emission factor 0.13 g/capita/year	EMEP(2000 a) ref. Berdowski et al. 1997)
PCBs from capacitors	Leaks	$E = Ef \cdot A$ E = PCB release (kg) Ef = Emission factor (kg/t) A = Number of capacitators * proportion of products with leaks	0.06 % 1.6 % (large capacitors)	Annema et al. (1995)
			Volume of leaks expected 1.6 kg/t Emission factor to air: none	EMEP (2000a) ref. TNO (1995)
			Volume of leaks expected 4.2 kg/t Emission factor to air: none	EMEP (2000a) ref. USEPA (1997)
			Volume of leaks expected 2.0 kg/t (leaks) Emission factor to air 0.8 kg/t	EMEP (2000a) ref. Belarusian report (2000)
PCBs from sealants	Air	$E = Ef \cdot A$ E = PCB emission (kg) Ef = Emission factor (kg/t) A = amount of PCB in product (t/a)	83.6 kg/t	Breivik et al. (2002b)
	To Air or soil from construction sealants	E = EF * V * M * C * f *1000 where E = releases [g] EF = emission factor [%] V = total volume of buildings [m3] M = mass of sealant per unit building volume [g/m3] C = concentration of PCBs in the sealant [mg/g] f = fraction of buildings containing PCBs in sealants [%]	0.1% of PCBs in sealants	Forsberg T in Saarinen et al (2014)
	Air and soil from window sealants	E = V * N * L* M * C * EF * 1000 where E = emission of PCBs to air [g] V = volume of building stock [m3] N = number of windows sealed	0.1% of PCBs in sealants	

		L = length of a window frame [m] M = mass of sealant per window frame [kg/m] C = concentration of PCBs in the sealant [g/kg] EF = emission factor [%]		
PCBs from surface coatings and adhesives	Air	$E = Ef \cdot A$ E = PCB emission (kg) Ef = Emission factor (kg/t) A = amount of PCB in product (t/a)	80 kg/t	EEA (2005)
NMVOCs from plastic bags	Air	E = A * EF* K where E = emission [kg/year] A = activity data [kg] EF = emission factor K = volatility index for a chemical *Activity data for the calculation* A = S * N where A = Total surface area of bags left in the environment [m2] S = Active surface area of a plastic bag (default LDPE bag 0.2 m2 and HDPE bag 0.09 m2) N = Number of plastic bags left in nature (unit count) *Unit count* N = U * P * R * L where N = Unit count of bags left in nature U = Average annual unit count of bags/person, default 50 bags/person/year P = Total population in the country or area for calculation R = Percentage of recycling, default 20% L = Approximated percentage of bags left in nature, default 10% For LDPE plastic bags a default value for U*R*L of 1.125 can be used.	For solvents the K value of 0.01 is assumed based on the assumption, that during 1 year, 1% of the total amount of volatile solvents in the bag material are released. For biodegradable bags the K value 1 can be used, assuming that all volatile components will evaporate during one year.	Munther J in Saarinen et al (2014)

	Water	E = A * K * EF where E = Release to water (kg/year) A = Activity data K = Percentage for releases to water, default value 0.598 EF = Emission factor *Activity data for the calculation* A = N * M where M = Mass for one unit (kg) default for common shopping bags: LDPE bag: 15-26 g/bag, HDPE bag 6 g bag (SFT, 2008). N = unit count (number of bags left in the nature, N), see calculation of N above for air.	EF = concentration of the chemical in shopping bags [kg/kg]. Default 0,0234	Munther J in Saarinen et al (2014)
MCCPs from cables and wires	Air	$E = Ef \cdot A$ E = MCCP release (kg) Ef = Emission factor (kg/kg) A = amount of MCCP in the product (kg)	0.0025 kg/kg (0.25%)	SFT (2004, 2009a)
	Water		0.0325 kg/kg (3.25%)	
	Soil		0.015 kg/kg (1.5%)	
MCCPs from building and construction products	Air	$E = Ef \cdot A$ E = MCCP release(kg) Ef = Emission factor (kg/kg) A = amount of MCCP in the product (kg)	0.0025 kg/kg (0.25%)	SFT (2004, 2009b)
	Water		0.0325 kg/kg (3.25%)	
	Soil		0.015 kg/kg (1.5%)	
SCCPs from paint and anticorrosive coating	Soil and water	$E = Ef \cdot A$ E = SCCP release (kg) Ef = Emission factor (kg/kg) A = SCCP volume in paints (t/a)	0.165 kg/kg (16.5%)	SFT (2004)
Musk compounds from the use of detergents and cosmetics	Waste-water	$E = Ef \cdot A$ E = musk releases (kg) Ef = emission factor (kg/kg) A = amount of musk compounds in the product (kg)	0.2 kg/kg (20%) not connected to WWTPs; 0.008 kg/kg (8%) connected to WWTPs	SFT (2004)
	Soil		0.36 kg/kg (36%)	

Substances used in sunscreens (e.g. EHMC, MBC, OC, BMDBM, BP3, siloxanes)	Water	$E = U * D * N * C$ E = Release of the substance (kg) U = Average daily use (average dose application multiplied by average full body surface and number of daily uses; default 20*2 g) D = Duration of a sun-bathing period (default 5 days) N = Number of tourists in the area C = Proportion of sunscreens washed off during swimming and bathing (default 25 %)	0.25 kg/kg (25%)	Danovaro et al. (2008)

8 REPORTING OF RELEASES FROM THE USE OF PRODUCT TO PRTRS

8.1 Current status of information on releases from products in the PRTRs

At the moment, diffuse releases, under which releases from the use of products fall, are not included in any PRTR system worldwide. However, national inventories on air emissions of certain chemicals released from the use of certain product groups are carried out on basis of reporting requirements to international air emission protection conventions. Such inventories include, for instance, emissions of non-methane volatile organic compounds (NMVOCs) from the use of solvent containing products under UNECE CLRTAP and UNFCCC conventions. Air emissions of heavy metals and certain persistent organic compounds (POPs) of certain product groups are included in inventories reported under the UNECE CLRTAP as well as ammonia emissions from the use of fertilizers. Releases of fluorinated greenhouse gases (F-gases, e.g. HFCs, PFCs and SF_6) from the use of products are included in the inventories reported under the UNFCCC.

A summary of the existing release inventories is compiled in Table 27. To build up a comprehensive picture on releases from products, national data already produced under the existing inventory processes should be collected and presented in the PRTRs.

Table 27. Existing inventories on releases from the use of products

Chemicals	Products	Environmental compartment	Countries
NMVOC	Solvent containing products[23]	A	Parties to UNECE CLRTAP National inventories in JP, KR
Heavy metals and particles	Tyre and brake wear[24], dental amalgam[25], fire work[12], cigarette smoking[12], light sources[13], paint[12], treated wood[12], fertilizer use[26] + various other products not generally included in inventories to CLRTAP	A, W, S	Parties to UNECE CLRTAP (NO also additional sources to CLRTAP reporting) National inventories in JP, KR National studies DK, SE
	Lead sheet and pipes	A, W, S	National inventories in BE, NL and regional inventories by the industry
	Fishing gear	W	National inventories in NL, NO
	Ammunition	W,S	National inventories in NL, NO
	Accumulators and batteries[12]		Parties to UNECE CLRTAP National inventories in KR
	Use of shoes	A	National inventories in France (Parties to UNECE CLRTAP)
Nitrogen	Fertilizer use[15]	A, W, S	Parties to UNECE CLRTAP
POPs	Pesticide and fertilizer use[15], treated wood (air) [12], tyre wear (air) [13]	A, W, S	Parties to UNECE CLRTAP National inventories in JP
Chlorinated chemicals	Use of chemicals[12]	A	Parties to UNECE CLRTAP National inventories in JP
F-gases	Refrigerant gases, various other products[27]	A	Parties to UNFCCC
POPs, heavy metals	Various products (referred to in the annexed case studies)	A, W, S	National studies DK, JP, NL, NO, SE, USA

(JP=Japan, KR=Korea, NL=the Netherlands, NO=Norway)

[23] CLRTAP: Included under the solvent and other product use sector

[24] CLRTAP: Included under the transport sector

[25] CLRTAP: Included under the waste sector

[26] CLRTAP: Included under the agriculture sector

[27] UNFCCC: Included under sector: consumption of halocarbons and SF_6

8.2 Product groups proposed to be included in PRTRs

Although chemicals released from products may have environmentally harmful properties, it may be that these chemicals are not released in such volumes or concentrations, or under such conditions that the releases may not be harmful to the environment. Existing stocks of old products still in use need also be taken into account when quantifying releases from the use of products. The use of recycled products is increasing, and this may increase releases of different chemicals from the use of products, as well as also complicate the quantification of releases.

As the work on quantifying releases is resource demanding and as quantification of releases from product use is a relatively new area in many countries, the aim is to identify those products that most likely have relevant releases from their use. Releases from products already included in existing inventory processes are excluded from the presentation in the document, as well as products from which the harmful releases may not be relevant for the environment. For instance, air emissions from a number of products, such as solvent containing products and pesticides, are already included in regular inventory work, while releases from the same products to soil and water may not be included in any existing inventory. Releases from products to wastewater treatment plants or to landfills are already included in PRTRs.

Releases to water, and especially to soil from many products, such as, car care products, may be highly harmful if released directly to the environment. Note that though releases of flame retardants present in many product groups are harmful to the environment, direct releases to the environment may be rare.

Results from the exposure work on harmful chemicals from the use of products carried out at the Swedish Chemicals Inspectorate (KemI) have been taken into account when preparing the conclusions. KemI prepares annually exposure indexes that are chemical specific and prepared for the following environments: “surface water”, “air”, “soil”, “WWTP” and “humans”. The work is based on information available in the Swedish Product Register (KemI 2005, KemI 2006; SNV 2003).

For the purpose of the document, the relevance of releases from the use of different products was considered in comparison with exposure information from KemI and other information collected in the case studies as presented in Tables A5.1 and A5.2 in Annex 5. The product groups presented in the Case Studies (Annex 1) were divided into the two groups below. Both groups include products with releases that are proposed to be taken into PRTRs, but especially for the second group of products, country-specific consideration of the relevance of releases is recommended.

1. Products that have relevant direct releases to the environment (Table 28)

2. Products from the use of which releases are not generally lead to the environment but from which possible direct releases to the environment are harmful (Table 29)

8.2.1 Products groups with relevant releases to the environment

Based on information collected during the preparation of this document it can be concluded that the following product groups have relevant releases to the environment from their use phase and that these releases are not yet included in regular inventory work:

- ammunition and fishing gear (lead), direct releases to the environment if left in soil or water
- building products (heavy metals, POPs and nonyphenols), direct releases to soil and water
- car and boat care products (nonyphenols), if releases lead directly to the soil

- electrical and electronic equipment containing mercury, direct air emissions
- pesticides, fungicides and antifouling agents: direct releases of heavy metals to soil and water

Table 28. Product groups with relevant releases directly to the environment

Product group	Description of releases	Relevance of releases to the environment
Ammunition and fishing gear	Lead released from ammunition and fishing equipment including lead containing weights, gun powder, explosives	Relevant lead releases if the products remain in soil or water. Prohibitions for the use or use conditions in some countries.
Building & construction products	Releases include heavy metals (e.g. lead in lead sheets, pipes and paint), wood impregnation agents (e.g. CCA) and different additives (e.g. plasticizers) in materials. The use of PVC plastics in construction and building products has increased but restrictions are applied in many countries on the use of Pb as stabilizer in PVC plastics. Though releases of certain hazardous substances have ceased, there may be large stocks left due to the previous extensive use (e.g. PCBs in sealants and caulk). Leaded sheets used in roofing and flashings as well as in pipelines may cause direct releases to the environment, bans in some countries while leaded constructions remaining in old buildings. Paint application releases lead and nonylphenols in addition to NMVOCs.	Relevant heavy metal, POP and NP/NPE releases if lead directly to soil.
Car and boat care products	Releases include windscreen washing agents, car shampoo, coolant, antifreezing agents, underbody compounds inclusive stone hit gards and fuel dope.	Relevant NP/NPE and cationic surfactant releases when lead to soil (not generally included in regular inventories).
Electronic and electrical equipment	The use volume has increased significantly over the years. Major releases include flame retardants used in the plastic casing and printed circuit boards, heavy metals (Pb, Hg) from solders and different components. Elevated concentrations of flame retardants have been found in indoor air and dust. Discarded electronics end often up in developing countries for disassembly or destruction. Metals recovered may be used e.g. to make low-cost jewellery. Heavy metals from light sources (energy saving lamps) and batteries, PCBs from capacitors and transformers.	Mercury emissions relevant to air from the use of Hg containing electronic products (partly included in regular inventory work), but bans for these products already exist in some countries. Also bans for PCB use in most of the countries. Direct releases to the environment from abandoned products are not relevant in countries with organized collection and treatment of EE waste. Direct releases may, however, enter soil through leakage and breakage of batteries, measurement equipment, capacitors, transformers or light sources.
Pesticide	Pesticide releases originate in the use for crop and vegetable protection leading to heavy metal and POP releases. Restrictions and bans for many pesticides (e.g. Pb, As) in many countries.	Air emissions included mainly in routine inventory work, releases to soil and water not generally. Use of environmentally harmful chemicals in pesticides is declining.
Textiles	Heavy metals and organic compounds from washing of textile products	Releases to waterbodies and soil may be relevant in areas where the wastewater is not lead to the receiving water body through WWTPs.

8.2.2 Product groups from which releases are not generally lead to the environment

Releases from pharmaceuticals and personal care products[28] as well as from toys and low-cost jewellery mainly have heath impacts and are generally not released directly to the environment but rather to wastewater treatment plants or landfills. There are exceptions to these, for instance substances from the use of sunscreens are released directly to water, and should thus be considered to be included in PRTRs under releases from product use.

The relevance of releases from textile and leather products, furniture and packaging material to the environment depends on whether there are direct releases to waterbodies (e.g. washing of carpets by a lake or sea without a connection to the sewer network to a wastewater treatment plant) or to soil (e.g. furniture in garden or packages left in the environment). The relevance of direct releases from these products should be considered against country-specific conditions (the relevance of releases is based on the product types and their local use practices as well as on the local product-specific legislation, wastewater treatment and waste handling practices).

Table 29. Product groups from which releases are not generally lead to the environment

Product group	Description of releases	Relevance of releases to the environment
Furniture	Releases of flame retardants (e.g. from mattresses and the foam in furniture), surface coating (e.g. dirt repellent carpets) and anti-mould agents (e.g. in couches). Plastic furniture may release phthalates and heavy metals, wooden furniture heavy metals and formaldehyde.	Relevant to the environment only if there are direct releases to the soil from use in open air.
Packaging and plastic bags	Releases include e.g. phthalates and heavy metals from PVC plastics, perfluorinated compounds used from oil resistant food packaging. Bans for lead and bisphenol-A in food packaging in most countries.	Relevant releases to the environment if the products left in soil and not delivered to organized waste management.
Pharmaceuticals and personal care products	Releases relevant to the environment if wastewater discharges are not lead to the receiving waterbody through wastewater treatment plants: e.g. antibiotics, hormones, disinfectants and detergents. The use of PPCPs is increasing as well as the number of chemicals included in the products.	Not released directly to the environment except NMVOCs and F-gases, which already are included in regular inventories and products like substances in sunscreens which have direct releases to water not generally covered by other inventories.
Textile and leather products	Releases include substances remaining in the product from the raw material cultivation (e.g. pesticide use in cotton fields), manufacturing (e.g. nonylphenols and heavy metals) and finishing (e.g. perfluorinated compounds) phase of the products. Use of PFOS, dimethylfumarate and axocolourants prohibited in many countries.	Releases may be relevant to health. Relevance to the environment depends on whether direct releases to waterbodies occur (e.g. washing of carpets in the open air without connection to the sewerage system).
Toys and low cost jewellery	Plastic toys have been found to contain heavy metals and different additives, such as phthalates, all having at least health effects. Releases from low cost jewellery related to the high contents of heavy metals (Pb, Cd, Ni) in the products, which have proven health effects.	Relevant to health but not to the environment.

The relevance of releases from nanoproducts is still unclear. A wide range of nanoproducts are in different everyday use, and new nanoproducts enter the market frequently, while there are only few studies on the environmental effects of substances at nano scale.

[28] except for sunscreen products

The list of products with relevant releases during their use phase, presented in Table 30, can be used when selecting product groups to be included into national PRTRs. The respective RETs are presented in Tables 21 -26 in Chapter 5.

The likelihood of releases needs to be considered case-by-case at the national level, taking into account the country specific conditions such as;

- product types used in the country, their chemical composition and likelihood to release chemicals
- country-specific use patterns of the products with conclusions of the relevance of releases
- existing restrictions or bans on products and/or chemicals in the products
- use volume of the product and assessment of the relevance of releases to the environment
- likelihood of direct releases to the environment from the use of the product

Table 30. Product groups and releases proposed for inclusion to PRTRs

Product group	Release	Environmental compartment	RET exists
Biocides (POP emissions and other existing release data to be transferred to PRTRs)			
Antifouling paints	Cu	Soil, water	Cu
Fungicides, herbicides, algaecides	Cu	Soil	Cu, HCB
Pesticides	Chemicals and remains as impurities in pesticides: HCB, HCBD, NP/NPE (DDT) (permethrin)	Soil	HCB, Cu, NP/NPE
Building and construction			
Adhesives	NPE, PCB	Water	NPE, PCB
Backfill material when lead to soil	SCCP	Soil	-
Cleaning agents (when lead to soil)	NPE	Soil	NPE
Colouring agents and paint	NPEs, SCCPs, Cr, Pb, antifouling: Cr, TBT	Water, air	NPEs, SCCPs, Cr, Pb, TBT
Concrete constructions	NP/NPE, MCCP, PCB	Water	NP/NPE, MCCP
Floor and wall covering (plastic)	NP/NPE, PCB, Pb, phthalates	Water	NP/NPE
Insulating material	BFR	Air, water	BFR
Jointing compounds if lead to soil	phthalates, PAH, BFR	Soil, water , air	BFR
Roofing, flashings, pipes	Pb, Cr, Ni, Cu	Soil, water	Pb, Cu
Sealants, fillers when lead to soil	PCB, MCCP, PCN	Soil	MCCP, PCB
Surface coating, paints	PCB, SCCP	Soil, water	PCB, SCCP
Wood preserves and impregnation agents	PAH, Cr, As, Cu	Soil	PAH, CCA: Cr, As, Cu
Car and boat care products (NMVOC emissions and other existing release data to be transferred to PRTRs)			
Coolants, if released to soil	anti-foulants, corrosion inhibitors, buffering and pH agents, heavy metals	Soil	-
Antifreezing agents if lead to soil	glycols, additives	Soil	
Car shampoo and car care products if lead to soil	NP/NPE, Cationic surfactants (DTDMAC, DSDMAC, DHTDMAC), detergents	Soil, water	NP/NPE, Cationic surfactants (DTDMAC, DSDMAC, HTDMAC), detergents
Underbody compounds, stone hit guards if lead to soil	TBT from antifouling paint	Water, Soil	TBT
Anti-knock agent if released to soil	MMT, iron pentacarbonyl, solvents	Soil	-
Electrical and electronic products (F-gas emissions and other existing release data to be transferred to PRTRs)			
Batteries	Hg, Pb, Cd (breakage/leakage from batteries manufactured earlier)	Air, water	Pb, Hg

Cables and wires	MCCPs, BFRs, PCB, phthalates	Air, water, soil	MCCPs, DEHP
Electrical equipment containing mercury	Hg (breakage/leakage)	Air, water	Hg
Enclosures and monitors	BRFs, PCB, PBDE	Air, water	BRFs
Light sources (breakage)	Hg (breakage/leakage)	Air, water, soil	Hg
Transformers, capacitors (leaks)	PCBs, HCBDs, PCNs	Air, water, soil	PCBs
Fishing and hunting			
Ammunition, gun powder, explosives (if to soil)	Pb, (HCBs from tracer bullets)	Soil, water	Pb
Fishing gear, lead containing weighs and impregnation agents in fishing nets	Pb	Water	Pb
Packages and plastic bags (in cases where left in the environment)			
Plastics (leach out e.g. plastic bags, if to soil)	phthalates, heavy metals HDPE,PCB, PAH	Soil	
Packaging material, if released to soil	BPA, NP/NPE	Soil	NP/NPE
Personal care products (in cases of direct releases to the environment)			
Detergents, cosmetics (in cases of direct releases to the environment)	NPEs, musk compounds, PFOA/PFOS, LAS, NH_3, phthalates, triclosan, heavy metals	Water	NPE, musk compounds
Pharmaceuticals (in cases of direct releases to the environment)	APIs, NPEs	Water, Soil, Air	NPEs, APIs
Sunscreens	E.g. EHMC, MBC, OC, BMDBM, BP3, siloxanes	Water	General method
Textile, leather, furniture (in cases of direct releases to the environment)			
Carpets (if washed outside sewerage system)	formaldehyde, phthalates, heavy metals, PFCs pesticides	Water	
Furniture foam and textiles	BFRs	Air, water	BFRs
Plastic furniture when releases directly to soil	phthalates, heavy metals	Soil	
Textiles (if washed outside a sewerage system)	HCB, BFRs, DMF, triclosan, NP, alkylphenols	Air, water	BFRs, NP
Wooden furniture (open air use when releases directly to soil)	PAH, formaldehyde, heavy metals, PFOA, HCB	Soil	Cr, Cu, As

9 CONCLUSIONS

9.1 Major findings on releases from product use

The basic assumptions at the beginning of this project were that both the use and the number of products are increasing, and that thus the share of releases from product use from the total releases is growing compared to industrial and other diffuse sources, and that also the global distribution of product related releases is rapidly expanding.

Sources that already are included in the reporting to PRTRs, e.g. product manufacturing, distribution and waste handling, were excluded from the scope of this document, and the efforts were concentrated on collecting information on releases generated during the actual use phase of end-products.

Based on the collected information it is evident that there are releases of hazardous chemicals to the environment from the use of certain product groups. In addition to air emissions that already are covered by the inventories submitted to international air protection conventions, there are relevant product use related releases of heavy metals and persistent organic pollutants, mainly to the soil and waterbodies, but also to the air.

Buildings are likely to be one of the main sources of direct releases to the environment not generally included in the existing inventories. In addition, car and boat care products, pesticides and the use of lead containing ammunition and fishing gear and mercury containing electrical and electronic equipment were identified to be relevant sources of direct releases. Textile and leather products, furniture and packaging material may have direct releases to the environment, if maintained or kept in open air without transferring the releases to a sewer network or landfill. This is also true for pharmaceuticals, personal care products as well as toys and low-cost jewellery, which generally only have health impacts.

A list of products proposed for inclusion into PRTRs is presented in Table 30 under Chapter 8.2. It is recommended that the relevance of releases from the proposed products is assessed against country-specific conditions.

9.2 Challenges

9.2.1 Global issues related to releases from the use of products

Though international and national work to restrict releases from the use of products is under way, no harmonized global approach concerning releases to the environment yet exists. It was observed that especially in countries where organized waste management practices and related legislation has not yet been implemented, releases from products are understood to cover also releases from waste handling, for instance disassembling of products for recycling purposes.

In a growing scale, the life-cycle of a product can be divided between different countries in the world, even the different parts of a single product can be made in different countries. For example, electronics, textile and toys that are produced in the Far East are used worldwide. Also, the used products can be shipped to other countries where the product parts can be recycled and used in new items. It is important to pay attention to the fact that although the national surveillance of chemicals in products would be well organized, follow-up of chemicals in imported products may be challenging. There is need for an internationally harmonized approach for both information sharing and legislation.

Some chemicals follow the product through the supply chain and end up where not expected. There may also be stocks of old products from which releases still occur.

9.2.2 Health and environmental impacts

More information is available on the health effects on releases from products compared to the actual environmental releases from the use of products. Though chemicals in products may impact health and the environment, those chemicals that have health effects do not always end up in the environment. For instance, releases from pharmaceutical and personal care products usually end up in sewage[29], which is lead to purification in wastewater treatment plants and releases from toys or low-cost jewellery do not enter the environment unless deliberately or undeliberately abandoned there and not taken to landfills.

9.2.3 Differences in the release levels from the use of products

Between the countries, there may also exist actual differences in the releases from products, due to the fact that release patterns and volumes differ largely in global respect. This is due to the use of different product groups and product types, and the chemical contents in the products. Also the use patterns and use volumes of similar products may vary between countries. International, regional or national restrictions or bans on certain products and/or chemicals in the products as well as voluntary initiatives by the industry or consumer demand all have their effect on the releases from the use of products.

In some countries the releases from certain product groups are already decreasing, even drastically, due to restrictions implemented on import, export or use of certain products with releases of environmentally hazardous chemicals. As an example, lead releases were cut drastically in the early 1990s in many countries due to the ban of leaded gasoline[30]. A similar phenomenon with the remaining lead releases in Norway was the ban on leaded bullets in hunting in 1995. After this, lead releases in Norway decreased additionally by over 80 per cent. Significant decreases are likely to have been reached also concerning other chemicals that have been regulated in the last decades, however, there is little information of quantification of these releases and their cuts.

9.2.4 Lack of routine inventory work and comparability of data

Routine inventories on releases to the environment from the use of products are carried out only in a few countries, namely in Japan, the Netherlands[31], Norway, and South Korea. In addition, regional inventories on releases from certain products and chemicals have been produced by the industry.

When comparing information on emission data presented in the different inventories, studies or research programmes on releases from the use of products, it can be seen that the results differ significantly. Often only the results are presented without documentation or justification of the methodology or explanation of products or activities[32] included or excluded. Thus it is difficult to conclude if there are actual differences

[29] For instance in the Nordic countries, wastewaters in the urban areas as well as in most cases also in the sparsely populated areas are lead either to municipal wastewater treatment plants or to property specific wastewater treatment systems.

[30] The transport sector was a dominating sector of lead releases in Europe, the USA and Canada until mid-1990. The use of leaded gasoline was banned and the releases of lead were decreased generally by over 90 percent in the countries.

[31] Excluding use of solvents, which is included in the regular inventory programmes in countries that report these releases under the UNFCCC and UNECE CLRTAP Conventions reporting programmes.

[32] Unlike the scope of this project (i.e. releases from the use phase of products) releases from products are often understood to cover the whole life-cycle of a product or at least several parts of it.

in the releases due to, for instance, different use practices or differences in the chemical contents of a given product, as described above.

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