ChEmiTecs
Mid-term report

Emissioner av organiska kemikalier från varor i teknosfären
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ChEmiTecs report P9-D2
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Organic Chemicals Emitted from Tecnosphere articles

Mid-term report

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1 Overarching programme aim and plan

The research programme Organic chemicals emitted from technosphere articles (ChEmiTecs) aims to increase the knowledge base and scientific understanding of the magnitude of the problem regarding emissions from articles, and to support policy development in Sweden and Europe.

The program is built on an integrated, scientifically focused and multi-disciplinary approach with model building and implementation as major tasks. We strive to create a common understanding of the problem and its context. An integrated approach to identification of substances and articles of concern is developed in the program, as well as a method to estimate the quantity of emissions of organic compounds from articles in society. The significance of these emissions is also assessed in relation to other emissions. Further, stakeholders' perceptions on the problem and behavioural responses to communication of chemical risks are investigated. Stakeholder interaction during the full extension of the project is used actively to safeguard the relevance of the programme continually and contribute to formulation of suggestions for problem reduction strategies and related indicators. Problem reduction strategies are analysed, both legislation and voluntary approaches. Indicators are outlined and assessed for their feasibility to support policies and strategies towards reducing the problem of chemicals emissions from articles. Finally, a synthesis is made by bringing together the research conducted throughout the Programme and pointing out potential ways forward starting from the knowledge base achieved.

The programme is structured into the Projects 1-8, External and internal communication (9) and Programme management (10) as outlined in Figure 1.

![Figure 1. Projects 1-8 and activities for Communication and Management constitute the programme ChEmiTecs](image)
In the process of granting the programme, the Swedish EPA (SEPA) requested from the consortium a further description and clarification of the procedure to achieve the emission quantification on the National level, beyond the originally submitted proposal. Such a clarification (Appendix 1) was submitted to and approved by SEPA. In practice, this has lead to a slight widening of scope compared to the original plan, in that the application of a method to estimate emissions on the National level is emphasised.

2 Status of projects

The projects in the ChEmiTecs programme have mainly proceeded according to plan in Phase 1. The individual project status is presented below, referring to the achievements made within each one of them. The status is specified in the ChEmiTecs deliverable reports (P#-D#) and as interim reports (P#-D#.IR). Both the deliverable reports and interim reports refer to original work (thesis, published articles and manuscripts) produced within the ChEmiTecs programme, making the half time report extensive. The original work on which the interim reports are based on are available upon request. The project status reports follows below, presented in one page each.
Project 1: Policy framework, concepts and indicators

The project aimed to initialize the conceptual development in the program by: a) a further refinement of the problems of chemicals in products; b) an initial concept modelling of the natural scientific/technical description of the factors and processes leading to emissions of substances from products; c) an identification of all problem aspects/dimensions investigated in the programme, d) an identification of indicators associated to the different aspects/dimension investigated, and e) initialize the collaboration between the researchers in the different projects and the stakeholder group and the main targeted audience of the results, i.e. the Swedish EPA (SEPA) and the Swedish Chemicals Agency (KemiI).

Activities carried out and delivered results
The project has performed two main research processes one related to the identification dimensions and aspects of the “dimensioning” or “sizing” of the problem in scope, and connected to this an identification and assessment of indicators for the “dimensioning”.

The methodological approach has comprised interaction with the reference group, literature work and an extended analysis of the suggested indicators. The process has resulted in a research report (P1-D1).

The other research process has focussed the conceptual modelling of the emission model. The method employed has been a combination of input from the reference group and very extensive elaboration within the team of researchers of Project 1 and 2 (P1-D2). In addition a literature review (P1-D5) has shed light on the research field and assured detailed input from other research and the originality of the ChEmiTecs-approach has been verified. To summarize the extensive work regarding the detailed scoping of the modelling performed by ChEmiTecs an additional report (P1-D6) has been written.

Additional and ongoing work in years 1-3
The work with a presentation of the model on SETAC NA conference is ongoing, furthermore is the work with a scientific research article ongoing.

Deviations from plan for years 1-3
No major deviations is reported, however, the literature review (P1-D5) was not planned but deemed essential for the outcomes of the conceptual modelling, additional work on project delimitations was also called for resulting in a second additional report. The work with the article (P1-D4) is somewhat delayed.

Links to other projects
The concept modelling has been a prerequisite for the ongoing work in Project 4, which is to be further developed into a fully working model. Furthermore, the interaction with the case study identification in Project 2 has been very fruitful for both projects. The work with the aspects/dimensions and the associated indicators are related to both Project 7 (problem reduction strategies differs due to what problem aspect/dimension that is considered) and Project 8.

The project has contributed significantly to the integration of work within the program through the direct links with Project 2, 4, 7 and 8.
**Project 2: Integrated identification of chemical/article/use combinations of concern**

This project aims to develop a systematic procedure to identify case study objects based on information on chemical properties, article characteristics, and known use patterns of articles. The procedure will be used to identify chemicals in products with use patterns that may lead to significant emissions of organic substances. The project interacts with the Swedish Environment Protection Agency, the Swedish Chemicals Agency, and other stakeholders in order to ensure efficient knowledge transfer to and from the research project and maximize its long- and short-term impact.

*Activities carried out and delivered results*

A systematic selection procedure of case study objects was developed during the first phase of the project resulting in the selection of the cases; diisononylphthalate in PVC-flooring, triphenyl phosphate in LCD-screens, tributyl phosphate in concrete, a benzothiazole in car tires, oleofolol (e.g., polyperfluorooctyl acrylate) in car textiles, and possibly a benzotriazole in coated textile (optional). In May and October 2008 workshops with 40-50 participants were organized aimed to provide input from industry, NGOs, and other stakeholders (P2-D1). In the selection process, chemical aspects of listed low and high production volume chemicals plus chemicals of special environmental concern were analyzed using calculated chemical descriptors, fate parameters, and novel multivariate clustering techniques. The chemical aspects of the selection procedure are described in detail in the publication by Rännar and Andersson, 2010.

In parallel, the national trade statistics were analyzed and filtered to identify groups of goods of concern for emission of organic substances. Trade statistics was combined with expert judgments on article use and design characteristics to filter out the potentially most relevant article groups. The final selection of case study objects was based on combining information on article life cycle, article volumes, and chemical properties. Most critical in this final process was knowledge on actual use of chemicals in articles and thus contacts with industry (P2-D2). In order to increase our understanding on environment abundance of selected candidate substances, representatives of benzothiazoles, benzodiamines, and benzotriazoles were suggested for inclusion on the Swedish EPA funded screening programme for 2009, see project 5. Results from this screening are expected during 2010 and will be used for a final decision of case study chemicals. Data from this project has been presented on EuroQSAR 2008, SETAC Europe 2009 and ICCE 2009 (Andersson et al. 2009a,b; Rännar et al. 2008).

*Additional and ongoing work in years 1-3*

Manuscript in preparation describing selection procedure and final decision on case study chemicals based on environmental screening.

*Deviations from plan for years 1-3*

No deviations to be reported

*Links to other projects*

The project exchanged a lot of information with Project 1 especially during the first year of the programme. The selected case objects are studied in Projects 3, 4, and 5 of the programme, and are considered in 6 and 7.
Project 3: Abiotic and biological stability of chemicals; (eco)toxicological considerations

The aim of this project is to contribute to the identification of chemicals of concern in articles and products and to assess the problem magnitude. More specifically:

3.1 to develop an improved methodology for identification of stable chemicals and compare with present available data;
3.2 to synthesize available data on bioaccumulated chemicals found in high trophic level wildlife (fish, birds and mammals) and in humans through meta analyses;
3.3 to identify compound (eco)toxicities in relation to prioritized test methods

Activities carried out and delivered results

3.1 Developmental studies of methods for oxidative and reductive reactivity for identification of chemical stability are in progress, as planned, to fulfil P3-D1 and P3-D2. Some professional reports are finalized so far (See P3-D1/D2-IR and applicable references* referred to therein).

3.2 Literature studies of existing data on accumulated chemicals in wildlife have been finalized (P3-D3) while a corresponding study on chemicals in humans is under way. A non-scheduled deliverable is added to P3, as a report regarding the selected case study chemicals (P3-D5a-IR). This literature study is addressing the case study chemicals occurrence in the environment and is forming part of the base for the work on the case chemicals in deliverable P3-D5 (see below).

3.3 A literature study of publicly available data, on toxicity and ecotoxicity for the case study chemicals, gathered in a database and summarized in an interim report (P3-D5b-IR). A scientific paper on the ecotoxicity of footware soles (Ingre-Khans et al, 2010)

Additional and ongoing work in years 1-3

3.1 The sub-project is developing as planned.

3.2 Results from the studies of existing data on accumulated chemicals in humans (P3-D4) will be completed during the year, concentrating the work on chemicals in human blood and milk.

3.3 The results on occurrence (P3-D5a-IR), and (eco)toxicity (P3-D5b-IR), on case-study chemicals for which very few data were found, will be merged into one report during the year. A modeling effort will be done for chemicals lacking (eco)toxicity data.

Deviations from plan for years 1-3

The work process for identifying and assessing the case studies required a special effort on retrieving literature and data on the chemicals identified as case study chemicals. This is reported in a separate study (P3-D5a-IR). Accordingly another deliverable, P3-D4 has been somewhat delayed, but will be reported in month 36. The P3-D3/D4 were indicated to be done as meta analyses in the original plan, but this will not be possible to do looking into the structured manner of meta analysis. There are no deviations from the initial plan concerning the gathering of (eco)toxicity data (P3-D5), except that data were searched for in Web of Science, Biosis, PubMed and Google Scholar instead of RTECS.

Links to other projects

Project P3 is strongly linked to P2. The two projects have so far developed in a close interactive manner, exchanging data with each other. P3 has been positively influenced by other ongoing projects related to in particular “Chemical Reactivity”. The data on occurrence is valuable input to P5. P3 is fully integrated in the full program.

* Scientific reports incl. thesis, articles and manuscripts (available upon request)
Project 4: Quantification of emissions

This project seeks fundamental understanding of the processes underlying the emissions of organic compounds from materials and articles, by compiling existing and generating new emission factors for combinations of substances, materials, and life cycle phases. Detailed case studies on objects selected in Project 2 will be carried out to further elaborate the understanding of the emission processes. A generic model for emissions of organic substances from articles will also be developed and implement the compiled emission factors. Ideally to be used to predict the emission of organic compounds from materials during any segment of the life cycle of an article, this model in combination with national statistics and surveys of article and waste flows in society will provide an estimate of national level emissions and how these can be expected to change over time.

Activities carried out and delivered results
A conceptual model has been developed for molecular level emission processes. This model complement the macroscopic conceptual model developed within project #1 for the overall emissions of organic compounds from the technosphere to the environment. Currently, the model can handle static partitioning processes, i.e. can estimate emissions during storage and other closed spaces. Further, a 1 m³ emission chamber has been built at UmU (P4-D3b-IR) for detailed emission studies of the article-chemical-use combinations (cases) that were selected within project #2. Significant time has also been invested in compiling article flow, article composition, and material composition data (joint effort with projects #1 and #2) to feed a generic numerical computer model that has been used to estimate the mass flow of overall annual emissions of organic compounds to the environment, until now for plastic materials in the stock of products in Sweden (P4-D4). In this work, also external experts at Statistics Sweden (SCB) have been consulted (P4-D3a).

Additional and ongoing work in years 1-3
Work is underway to expand the quantitative model to handle dynamic partitioning processes in, for example, outdoor environments. Emission measurements using the emission chamber will also be started. The data will be used to improve and/or verify the generic emission model, which will also be expanded to take into account the waste management. Refined additive content in polymers is elaborated together with external experts (Swerea IVF)

Deviations from plan for years 1-3
The pioneering work carried out to compile article flow, article composition, and material composition data required for the emission modeling has proven more difficult than expected. As a result, delivery P4-D4 “A report on the results of the National scale and future flow modeling” was postponed to month 30. Also, delays in the construction of the emission chamber and a 6-month parental leave of the PhD student working on the project have delayed the project deliverables. These factors will be reflected in a revised time plan for deliverables in phase 2 (Section 7)

Links to other projects
Project 4 draws on Projects 1&2, and links strongly to work in Project 5.
Project 5: Relative importance of emissions from articles

The overall aim of this project is to estimate the magnitude of the emissions of selected organic substances/groups of substances from articles in relation to other emission categories and pathways. The following sub-objectives have been identified:

- To estimate and assess the importance of diffusive distribution of the selected substances in relation to other sources in an urban area, Stockholm.
- To extrapolate the results from Stockholm to the rest of the country.
- To identify sampling strategies for monitoring of diffusive distribution of chemicals.

Activities carried out and delivered results
The work in P5 is in its initial phase and has been focussed on a) setting up the methodology for substance flow analysis (SFA) and initiating the work on data collection to study the source strength of articles compared to other sources and b) developing a local-scale dynamic mass balance fugacity model for an urban area, including an extra module representing the indoor compartment. This model will be used with input from P2 (properties), P3 (persistence, degradation, occurrence data), P4 (emissions) and P5 (emissions, monitoring data) to predict the key transport routes for individual substances, the resulting environmental concentrations, with potential for comparison to toxic levels (P3) and to highlight the importance of the urban environment as a source or sink of chemicals emitted from technosphere articles.

Additional and ongoing work in years 1-3
The first deliverable, Emission inventories of different source categories on a local (urban) and national scale for the selected case study objects due in month 36, i.e. in the end of year 3 (November 2010).

The local-scale mass balance model will be finalised during phase 1 and initial test-runs performed, after which calibration/validation and realistic model simulations with sensitivity analysis can be initiated. In parallel to the project a screening study for benzothiazoles, benzotriazoles and benzenediamines is currently being conducted (separate funding from SEPA). The results from the screening study will feed into a later deliverable P5-D2 (official due date month 48).

Deviations from plan for years 1-3
No deviations of importance from original plan.

Links to other projects
Project P5 has strong linkages to P2 – identification of case study objects and makes use of input form P4 – quantification of emissions. In particular, P5 benefits from these as they provide important model input. P5 also provides crucial information to P7 and P8 regarding source strength of articles compared to other sources, and process modelling will give useful insight about possible measures as the effect of such measures can be simulated with fate models and LCIA tools.
Project 6: Problem perception

This project aims to investigate how different actors, in particular producers and consumer, perceive the potential risk of chemicals in articles. Also, ways of communicating these risks will be investigated. It was also an objective in this project to examine how perception affects behavior of producers and consumers.

Activities carried out and delivered results
Two survey studies have been performed. The questionnaires are available in Appendices 6.1. and 6.2.
The first survey was conducted among five groups of producers. Five groups of articles were selected based on the identification of substances in P2. The groups of articles selected were: electronics, textiles used in furniture, plastics used in primarily flooring, car tires and shoes. A total of 101 producers within these groups completed a survey consisting of 23 items.
The second survey, focusing on consumers, was distributed to 2000 consumers and consisted of 28 items. This survey is based in part on the Eurobarometer survey focusing on consumer perception of chemicals carried out in January-February 2009. This will enable a comparison between the Swedish data with European data. The Eurobarometer is a survey tool used within the European Union that measures the attitudes and opinions among citizens in the member states.

Additional and ongoing work in years 1-3
In Project 6, three reports will be produced focusing on risk perception (P6-D1), communication (P6-D2) and behavior (P6-D3, scheduled in Phase 2, month 42).

Deviations from plan for years 1-3
P6-D1 has been postponed to be delivered in month 36. Apart from that, the project runs according to plan.

Links to other projects
Project P6 is closely linked to Project 7 since the survey distributed to producers included items relevant for both P6 and P7. Articles selected as survey objects are chosen among the case study articles selected in Project 2.
**Project 7: Problem reduction strategies of chemicals in articles**

The aim of the project is to generate proposals and recommendations to improve mandatory and voluntary strategies for risk reduction. This is done by analyzing the strengths and weaknesses of three strategies to handle risks associated with chemicals from articles towards different actors: (1) the chemicals legislation (P7-D1), (2) the Swedish Environmental Quality Objectives (P7-D2) and (3) voluntary initiatives (P7-D3 and P7-D4).

**Activities carried out and delivered results**

P7-D1: A detailed analysis of the available major European legislations that concern chemicals in articles has been performed, covering: REACH, the Toys Safety Directive, the RoHS Directive, the Medical Devices Directive, the Construction Products Directive and the Cosmetics Directive. The analysis shows that different approaches have been used within these regulatory frameworks. These differences will affect the process of substituting hazardous chemicals in articles. Some of these differences seem to be unsystematic or based on non-scientific deliberations. (P7-D1-IR; Molander and Rudén, 2010)

P7-D2: A survey has been conducted among five groups of producers working in the fields of electronics, textiles used in furniture, plastics used in primarily flooring, car tires, and shoes (see project 6). Six out of twenty-three items in the survey concerned the environmental quality objective "A non-toxic environment". The items were designed to obtain information about the status of the objective as driving force for the producers’ environmental work (items attached in appendices 6.2). The results of the survey will be analyzed and are due to be communicated in month 48. A preliminary analysis of acquired data indicates that the significance of the objective as a regulative force in chemical risk management for articles is very limited.

P7-D3 and P7-D4: Two externally funded (see Section 5) pilot projects on risk assessment of chemical in building products have been completed. The projects resulted in a study report (P7-D4) and a database designed for construction products with certain hazardous properties and risk handling strategies. A paper on “Strategies for voluntary means for problem reduction of emissions of organic substances from articles” (P7-D3) has been initialised.

**Additional and ongoing work in years 1-3**

The analysis of the major European legislations that concern chemicals in articles described above will be finalized. The manuscript is currently reviewed by selected experts at the Swedish Chemicals Agency, including legal experts.

**Deviations from plan for years 1-3**

The externally co-funded study on Green Chemistry (P7-D5) has not commenced, due to lack until now of the necessary co-funding. The study will now start in September (Ekberg et al, 2010)

**Links to other projects**

Project 7 is closely linked to Project 6 since the same surveys are used in both projects. There are also links to several indicators compiled and elaborated in Project 1.
**Project 8: Operationalisation and synthesis**

The aim of this project is to make a synthesis of all the research carried out in the programme and point out potential ways forward.

**Activities carried out and delivered results**

The project has started looking at the institutional conditions, by engaging existing information system holders, in particular The Swedish Chemicals Agency, and Statistics Sweden, investigating the current and potential future information sources and information flows to sustain an information system on emissions from articles. On the issue of statistics for product flows, the report P4-D3a serves a double purpose, as it also contributes directly to the emission estimates in Project 4. Further the project has started collaboration with the OECD PRTR Task Force on emissions from products and the Swedish emission reporting consortium SMED, regarding emissions of hazardous substances from products.

**Links to other projects**

Until now, the main links have been with Project 1, but clearly Project 8 relies on research and findings in all ChEmiTecs Projects.
3 Key Results from Phase 1

Our research in Phase 1 has built broad-based knowledge regarding aspects and magnitude of the problem of emissions from articles. Important results have thus already been achieved in phase 1, both with respect to the characterisation of the problem and the possibility to reduce it.

The framing of the problem at hand and delimitation of the task in order to make it manageable has been carried out within project 1 by a description of the diverse aspects relating to emissions from articles (P1-D1). The study has focused on a preliminary identification of the aspects (or “dimensions”) and then defined 58 new indicators, i.e. measurable entities that each represents a defined aspect of the problem. These indicators fall into three broad categories: i) those pertaining to the cause-effect chain; from drivers causing chemicals to be used, to effects on man and the environment (28 indicators); ii) indicators pertaining to the perception of chemical risks and awareness among stakeholders (3 indicators); and iii) indicators describing conditions for and implementation of risk reduction measures and strategies (27 indicators). The study shows that the problem with chemicals in articles is an extremely complex and multifaceted problem. The mere description of it brings considerable challenges, both theoretical and practical.

Project 1 has also produced a unique conceptual macro-model (P1-D2) useful for the subsequent design in Project 4 of the model for estimating emissions. The conceptual model applies a new approach that combines the concepts of “chemical substance”, “material”, “product” and “use” in order to underpin consistent calculations of emissions of substances from different products under their various uses, which also is related to life-cycle stages. The further specification of the conceptual model, in order to cover different e.g. waste handling and recovery, will take place in the second stage of the ChEmiTecs-program.

A novel tool to select structurally diverse chemical substances was developed in project 2 based on hierarchical clustering in combination with multivariate chemical characterisation (Rännar and Andersson, 2010). The methodology allows flexible selection procedures where in addition to chemical variation factors, such as environmental abundance, production volumes, and chemical analytical issues can be considered. This procedure was integrated in the case study selection process developed to identify cases combining variation in types of articles, their use pattern, and chemical aspects (P2-D2; P2-D3-IR). All programme partners were engaged in the selection procedure. Therefore the procedure also contributed significantly to the common understanding and vocabulary (i.e. the concept model) in the programme consortium about the emission driving mechanisms.

The studies of chemical stability, contributing to assessing persistency, have taken a big step forward within project 3 since we now have established methods for studies of both oxidations and reductions (see P3-D1-IR). The combined set of procedures for assessing chemical stability has been applied to a set of phthalate acid ester and a tri-aryl phosphate ester (manuscript in P3-D1-IR) showing all reactant to be highly stable to photolytic transformations and oxidations. The phthalate esters are labile to base but under neutral conditions we know the esters to be very slowly reacting species. Most intriguing is the very low reactivity of the trisphenyl phosphate (TPP), a compound
belonging to the group of case study chemicals. The chemical reactivity results are promising, indicating the desirable predictivity of chemicals behaviour in the abiotic environment.

After final decision of the case study chemicals, literature surveys were initiated to collect data on environmental and human exposure and environmental and health effects (P3-D5a and b-IR). It is intriguing how few reports there are in the scientific literature for almost all the case study chemicals. The number of scientific reports counts to 10, or in many cases less than so, for exposure and effects, respectively. The only case study chemicals with a larger number of scientific reports are the polyfluorinated compounds (PFCs) and to a lesser extent the phosphate esters. The work is stressing an enormous data gap for most of the case study chemicals, making any form of hazard assessment difficult and risk assessments practically impossible.

In project 4 we have brought the emission quantification further in two parallel lines of activity. In the first line we have built an emission chamber in which we have measured emissions from product samples in accurately controlled conditions. Until now, PVC flooring has been analysed. The measured emissions will be used to provide input to, and subsequently verify, a computational model ("micro-level") which is designed to model emissions from articles. This modelling will be used in the national emission estimates during years 4-5 of the programme. In the parallel line of activity, we have developed a macro-level model to estimate the economy-wide emissions from articles, and applied it in a first iteration to the Swedish economy (P4-D4), covering the estimated amount of emissions for about 300 specific chemicals from a variety of products containing plastic materials. We stress that this estimate has currently large uncertainty and should be interpreted with great caution until the estimate is improved and uncertainty reduced by further refinement during years 4-5.

Assessment of the relative importance of article-borne emissions has been initiated in project 5 for the selected case study chemical di-iso-nonyl phthalate (DINP), by studying the source strength for all sources for DINP contributing to its occurrence in the environment using substance flow analysis methodology. Preliminary results indicate two major pathways of release to the environment, atmospheric deposition (8 tonnes/year) and release via sewage treatment plants (STPs: 1.6 tonnes/year). As STPs are collection points for several societal flows of chemicals these emissions capture release from products as well as other flows (e.g. small enterprises, human excretion stormwater flows etc). Circa 1 tonne/year is estimated to be spread on agricultural land as a result of accumulation in sewage sludge. Flows that remain to be studied are e.g. emissions via waste incineration and recycling processes. These flows will be compared to the predicted flows of DINP generated in Project 4.

A local-scale urban fate model including the indoor environment is in its final stage of development. This model will be used to highlight the emissions and transport processes typical of chemicals released from products in densely populated areas. An additional aim with the model is to apply it in the case study area Stockholm to connect estimated emissions to observed environmental concentrations, and to study the important processes affecting these, and thus toxicity and environmental impact.

We have also applied advanced impact assessment models (LCIA) from the life cycle assessment domain in a thesis assessing emissions from car tyres (Einarsson, 2009). The LCIA-tool used, Omnitox IS, was mainly developed in an earlier EU project, but made
operational, as planned, in phase 1 in ChEmiTecs (P2-D4). The mathematical uncertainty in the Omnitox model was assessed in a Master's thesis (Lundtofte, 2009), which has highlighted the sensitivity of such models to the assumption regarding the nature constants.

We have completed two survey studies in project 6 and have chosen to focus on five case-study products. These products are LCD televisions, PVC flooring, car tires, textiles used in furniture and shoes. Two products that are not included in the program as case products were included for comparison: glass products and plastic household products. When comparing producer and consumer perception of these products, some differences were observed. Both groups were asked to rate possible risks with the above mentioned seven products. Preliminary results show that both groups rate car tires as being most harmful for human health and the environment, with textiles used on furniture on second place. Household plastic products are rated to be least harmful by the consumers, but are rated higher by the producers. These results imply that there are differences in risk perception between producers and consumers. Possible consequences this might have for risk communication and consumer behaviour will be further investigated. Overall, the results indicate that none of the selected products are of very large concerns for consumers as the perceived risk is reported to be low.

The need to strengthen the legislation concerning chemicals in articles is widely recognized nationally as well as internationally. However, there is currently no consensus about what such legislation should look like. In project 7, current EU rules on chemicals in different types of articles are analysed and compared. A general conclusion in this study is that the availability of information about the chemical contents of different articles as well as about the properties of individual chemical substances need to be improved. It is furthermore concluded that the legislations under scrutiny have different scopes and solutions. Some are general and criteria based while others focus on risk management of substances already identified as problematic. There are advantages and disadvantages with both approaches. An advantage of using a substance specific approach is that it will have a direct effect on information generation, information dissemination and substitution. An example of this is the RoHS directive. The aim of this study is to contribute to international negotiations in this field. The analysis is performed with expert input from the Swedish Chemicals Agency. The results are reported in a manuscript that will be submitted for publication in an international peer reviewed journal.

Within the scope of Project 8, we have achieved jointly with Project 4 a first study for one of the case study articles, PVC flooring (P4-D3a), investigating existing information flows of articles in official databases. It indicates where information sources are available, and where new information nodes are lacking or insufficient and need to be developed in order to create information flows useful for monitoring of substances in articles.

All in all, Phase 1 has generated and continues to generate a good knowledge base and a rich flora of results regarding the many aspects - technical, scientific and social - of the complex issue to understand as well as formulate policies and strategies to reduce the problem with emissions of organic substances from articles.
4 Programme management and organisation

The ChEmiTecs team includes 25 researchers in total (Table 2). Of these, thirteen are senior researchers (Professors or PhDs). Four PhD candidates are engaged in the programme. Two of these are mainly funded by the ChEmiTecs programme, while two are co-funded by ChEmiTecs and other programmes or projects.

A Programme Management Committee has been established, consisting of two representatives each from the Swedish EPA, the Swedish Chemicals Agency and Statistics Sweden, together with the programme manager, the communications manager and the Project managers, with a stand-in to allow two representatives per partner in the programme from ChEmiTecs (Table 3). The Management Committee has provided valuable guidance to the programme in strategic issues and thus helped steering the programme. The Committee has convened three times during the project (Table 4).

The internal coordination of programme activities is organised in a Coordination team, consisting of the programme internal part of the Management Committee. The Coordination team has convened four times, "live", in connection with major assemblies in the programme (Table 4). In between, telephone meetings with the Coordination team have been held once in every two months on average.

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<tr>
<th>ChEmiTecs Team member</th>
<th>Title</th>
<th>Partner</th>
<th>Role in programme</th>
<th>Share of time spent on ChEmiTecs Year 1-3</th>
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<tr>
<td><strong>Programme &amp; Project management</strong></td>
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<tr>
<td>Tomas Rydberg</td>
<td>PhD</td>
<td>IVL</td>
<td>Programme Manager, Participant in Projects 1, 2, 4, 7 and 8</td>
<td>25 %</td>
</tr>
<tr>
<td>Jeanette Green</td>
<td>MSc</td>
<td>IVL</td>
<td>Communication Manager, Manager of Project 7 (2009-April 2010)</td>
<td>10 %</td>
</tr>
<tr>
<td>Anna Palm Cousins</td>
<td>MSc, PhD cand</td>
<td>IVL</td>
<td>Communication Manager, acting (2008), Participant in Projects 1, 2, 4 and 5</td>
<td>20 %</td>
</tr>
<tr>
<td>Sverker Molander</td>
<td>Professor</td>
<td>Chalmers</td>
<td>Manager of Project 1, Participant in Project 2, 4 and 8</td>
<td>25 %</td>
</tr>
<tr>
<td>Patrik Andersson</td>
<td>Assoc. Professor</td>
<td>UmU</td>
<td>Manager of Project 2</td>
<td>10%</td>
</tr>
<tr>
<td>Åke Bergman</td>
<td>Professor</td>
<td>SU</td>
<td>Manager of Project 3, Participant in Projects 1, 2, 3</td>
<td>8 %</td>
</tr>
<tr>
<td>Peter Haglund</td>
<td>Professor</td>
<td>UmU</td>
<td>Manager of Project 4</td>
<td>10%</td>
</tr>
<tr>
<td>Eva Brorström-Lundén</td>
<td>PhD</td>
<td>IVL</td>
<td>Communications Manager (from April 2010), Manager of Project 5, Participant in Projects 1 and 2</td>
<td>10 %</td>
</tr>
<tr>
<td>Misse Wester</td>
<td>PhD</td>
<td>KTH</td>
<td>Manager of Project 6</td>
<td>30%</td>
</tr>
<tr>
<td>Anna Jarnehammar</td>
<td>MSc</td>
<td>IVL</td>
<td>Manager of Project 7</td>
<td>2 %</td>
</tr>
</tbody>
</table>

Table 2: The ChEmiTecs Team. The share of time is an estimated, rounded average over the two and a half years until May 2010 of the programme. Several members made concentrated efforts during much shorter time.
<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katarina Schough</td>
<td>Swedish EPA</td>
</tr>
<tr>
<td>Erik Westin</td>
<td>Swedish EPA</td>
</tr>
<tr>
<td>Nils-Gunnar Lindqvist</td>
<td>Chemicals Agency</td>
</tr>
<tr>
<td>Karin Thoran</td>
<td>Chemicals Agency</td>
</tr>
<tr>
<td>Annika Carlsson</td>
<td>Statistics Sweden</td>
</tr>
<tr>
<td>Louise Sörme</td>
<td>Statistics Sweden</td>
</tr>
</tbody>
</table>

Table 3: External stakeholders representatives in the Management Committee.
<table>
<thead>
<tr>
<th>Date</th>
<th>Participants</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008-02-05</td>
<td>The ChEmiTecs team</td>
<td>Formal Kick-Off for Programme</td>
</tr>
<tr>
<td>2008-05-20</td>
<td>The ChEmiTecs team, Management committee,</td>
<td>Management committee meeting &amp; Coordination team meeting, back-to-back</td>
</tr>
<tr>
<td></td>
<td>Coordination team</td>
<td>with Reference group meeting</td>
</tr>
<tr>
<td>2008-10-14</td>
<td>The ChEmiTecs team, Coordination team</td>
<td>Programme general assembly &amp; Coordination team meeting, back-to-back</td>
</tr>
<tr>
<td></td>
<td></td>
<td>with Reference group meeting</td>
</tr>
<tr>
<td>2008-12-08</td>
<td>Management committee</td>
<td>Management committee meeting</td>
</tr>
<tr>
<td>2009-09-29</td>
<td>The ChEmiTecs team, Management committee,</td>
<td>Management committee meeting, back-to-back with Reference group meeting</td>
</tr>
<tr>
<td></td>
<td>Coordination team</td>
<td></td>
</tr>
<tr>
<td>2009-12-02/03</td>
<td>The ChEmiTecs team, Coordination team</td>
<td>a) Programme general assembly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) Coordination team meeting</td>
</tr>
<tr>
<td>2010-03-15/16</td>
<td>The ChEmiTecs team, Coordination team</td>
<td>a) General assembly mid-term report planning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) Coordination team meeting</td>
</tr>
<tr>
<td>2010-05-26</td>
<td>The ChEmiTecs team</td>
<td>Programme meeting to refine plan for years 4-5</td>
</tr>
</tbody>
</table>
5 Programme communication

5.1 Major communication events

The programme has established a reference group with representatives from public authorities (Swedish EPA [SEPA], the Swedish Chemicals Agency [Kemi], and Statistics Sweden [SCB]), professional purchasers and producers of chemicals and articles, and researchers from outside the ChEmiTecs consortium. The reference group was gathered on three occasions with different focus areas: indicator identification (2008-05-21), integrated identification of chemicals and articles and reduction strategies (2008-10-13) and problem reduction strategies (2009-09-28) (Table 5). The reference group was also invited to the conference in May 2010: Kemikalier i varor – REACH och vägen framåt (Chemicals in articles- REACH and the way forward). The programme is available on the Programme website, at http://www.chemitecs.se/eventemang. The participants in the Reference group are listed in Table 6.

<table>
<thead>
<tr>
<th>Date</th>
<th>Participants</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008-03-25</td>
<td>All partners, SNV, Kemi, SCB, Municipality of Stockholm</td>
<td>Stakeholder dialogue meeting to provide initial input to P2 selection procedure</td>
</tr>
<tr>
<td>2008-05-21</td>
<td>All partners, Reference group</td>
<td>Reference group meeting to provide input to P1-D3 &amp; P2 selection procedure</td>
</tr>
<tr>
<td>2008-10-13</td>
<td>All partners, Reference group</td>
<td>Reference group meeting to provide input to P2 selection procedure</td>
</tr>
<tr>
<td>2009-04-01-04</td>
<td>Chalmers, IVL, UmU</td>
<td>Information exchange and Study tour to JRC Ispra</td>
</tr>
<tr>
<td>2009-09-28</td>
<td>All partners, Reference group</td>
<td>Reference group meeting to provide feedback on their input to P1-D3, and general update of Programme status</td>
</tr>
<tr>
<td>2010-05-25</td>
<td>All partners, Management committee, Reference group, Other external interested parties</td>
<td>ChEmiTecs mid-term conference on the topic of Chemicals in articles- REACH and the way forward?</td>
</tr>
<tr>
<td>Name</td>
<td>Organisation</td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Karin Andersson Halldén</td>
<td>Akzo Nobel Technology &amp; Engineering</td>
<td></td>
</tr>
<tr>
<td>Gudrun Bremle</td>
<td>Länsstyrelsen Jönköping</td>
<td></td>
</tr>
<tr>
<td>Urban Ledin</td>
<td>Banverket</td>
<td></td>
</tr>
<tr>
<td>Joel Görsch</td>
<td>Business Region Göteborg AB</td>
<td></td>
</tr>
<tr>
<td>Per Baumann</td>
<td>COOP Sverige</td>
<td></td>
</tr>
<tr>
<td>Frans Christensen</td>
<td>European Commission, DG JRC</td>
<td></td>
</tr>
<tr>
<td>Hans Wendschlag</td>
<td>Hewlett-Packard</td>
<td></td>
</tr>
<tr>
<td>Ernst Hollander</td>
<td>Högskolan i Gävle</td>
<td></td>
</tr>
<tr>
<td>Björn Frithiof</td>
<td>IKEA</td>
<td></td>
</tr>
<tr>
<td>Jerker Lichtart</td>
<td>Internationella Kemikaliesekretariat</td>
<td></td>
</tr>
<tr>
<td>Ewa Thorslund</td>
<td>IT-Företagen</td>
<td></td>
</tr>
<tr>
<td>Erik Noaksson</td>
<td>Jegrelius Forskningscenter</td>
<td></td>
</tr>
<tr>
<td>Petra Ekblom</td>
<td>Kemikalieinspektionen</td>
<td></td>
</tr>
<tr>
<td>Stellan Fischer</td>
<td>Kemikalieinspektionen</td>
<td></td>
</tr>
<tr>
<td>Margareta Östman</td>
<td>Kemikalieinspektionen</td>
<td></td>
</tr>
<tr>
<td>Helena Bergström</td>
<td>Konsumentverket</td>
<td></td>
</tr>
<tr>
<td>Elisabeth Lindqvist</td>
<td>Länsstyrelsen i Västra Götaland</td>
<td></td>
</tr>
<tr>
<td>Magnus Rönemark</td>
<td>Magnus material och miljö (previously at Forbo Flooring AB)</td>
<td></td>
</tr>
<tr>
<td>Frida Hok</td>
<td>Chemsec (previously at Naturskyddsföreningen)</td>
<td></td>
</tr>
<tr>
<td>Andreas Prevodnik</td>
<td>Naturskyddsföreningen</td>
<td></td>
</tr>
<tr>
<td>Britta Hedlund</td>
<td>Naturvårdsverket</td>
<td></td>
</tr>
<tr>
<td>Niklas Johansson</td>
<td>Naturvårdsverket</td>
<td></td>
</tr>
<tr>
<td>Kjell Johansson</td>
<td>Naturvårdsverket/SLU Institutet för Miljöanalys</td>
<td></td>
</tr>
<tr>
<td>Charlotte Bejersten Nalin</td>
<td>NCC Construction Sverige AB</td>
<td></td>
</tr>
<tr>
<td>Anders Normann</td>
<td>Plast- &amp; Kemiöretagen</td>
<td></td>
</tr>
<tr>
<td>Michael Reineskog</td>
<td>Plast- &amp; Kemiöretagen</td>
<td></td>
</tr>
<tr>
<td>Frank Schlüter</td>
<td>Scania CV AB</td>
<td></td>
</tr>
<tr>
<td>Sara Widman</td>
<td>Siba AB</td>
<td></td>
</tr>
<tr>
<td>Jeanette Sveder Lundin</td>
<td>Skanska Sverige AB</td>
<td></td>
</tr>
<tr>
<td>Charlotta Brask</td>
<td>SLL</td>
<td></td>
</tr>
<tr>
<td>Hans Gustafsson</td>
<td>SP Sveriges Tekniska Forskningsinstitut</td>
<td></td>
</tr>
<tr>
<td>Caisa Wahlberg</td>
<td>Stockholm Vatten AB</td>
<td></td>
</tr>
<tr>
<td>Anna Linussson</td>
<td>Stockholms Läns Landsting</td>
<td></td>
</tr>
<tr>
<td>Arne Jamtrot</td>
<td>Stockholms Stad</td>
<td></td>
</tr>
<tr>
<td>Inger Soldéus</td>
<td>Svensk Handel</td>
<td></td>
</tr>
<tr>
<td>Anders Finnson</td>
<td>Svenskt Vatten</td>
<td></td>
</tr>
<tr>
<td>Danielle Freilich</td>
<td>Sveriges Byggindustrier AB</td>
<td></td>
</tr>
<tr>
<td>Hannele Nurmi</td>
<td>Volvo AB</td>
<td></td>
</tr>
</tbody>
</table>
5.2 Follow-up of other communication products

Communication products from ChEmiTecs consist of the items indicated in Table 7. The full list of scientific papers/manuscripts, conference abstracts/contributions, oral presentations, reports, etc, produced within ChEmiTecs, are listed in Appendix 2.

Table 7: Communication products as planned in the original programme plan, the schedule according to this plan, and the status June 2010

<table>
<thead>
<tr>
<th>Communication product</th>
<th>Schedule according to original plan</th>
<th>Status, June 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Webpage (in Swedish, some parts in English)</td>
<td>Start beginning of the programme, regular updating</td>
<td>Completed. For further information visit <a href="http://www.chemitecs.se">www.chemitecs.se</a></td>
</tr>
<tr>
<td>Internal webpage</td>
<td>Start beginning of the programme, regular updating</td>
<td>Completed. For further information visit <a href="http://www.chemitecs.se">www.chemitecs.se</a></td>
</tr>
<tr>
<td>Progress report</td>
<td>Half time through programme (mid-term report) and end of programme</td>
<td>This report is the mid-term report</td>
</tr>
<tr>
<td>Progress report</td>
<td>Yearly</td>
<td>Was completed for 2008 but will be replaced by the overall reporting for extension of the project for years 4-5 during 2010.</td>
</tr>
<tr>
<td>Communication plan</td>
<td>Year 1, thereafter updated when needed</td>
<td>Resources have been allocated to the participation of programme participants in expert meetings and to encourage the discussion with the stakeholders. The periodicity of the news letter has therefore been reduced to being published yearly.</td>
</tr>
<tr>
<td>Press releases</td>
<td>When launching the programme, thereafter when appropriate</td>
<td>A press release was issued when the programme was started. Since then no press releases have been issued.</td>
</tr>
<tr>
<td>Presentation material (information leaflet, PowerPoint presentation material)</td>
<td>Year 1, thereafter updated when needed</td>
<td>Completed during year one. Digital versions can be found at the internal web-site. More than ten oral presentations on the programme have been presented to a variety of audiences (Appendix 2)</td>
</tr>
<tr>
<td>Newsletter (electronic)</td>
<td>Every 6 months</td>
<td>Three news letters were produced from the start of the programme until now (December 2008, June 2009, March 2010), available at <a href="http://www.chemitecs.se/nyheter/chemitecsnyhetsbrev">http://www.chemitecs.se/nyheter/chemitecsnyhetsbrev</a>. As the programme proceeds and will deliver more news material the number of news letters could increase to comply with the communication plan.</td>
</tr>
<tr>
<td>Deliverables (Technical reports, papers, workshop reports, etc)</td>
<td>According to deliverable list</td>
<td>See Table 8 (deliverable status), and Appendix 2 (Full list of publications and presentations)</td>
</tr>
</tbody>
</table>
Table 8: Summary list of deliverables from Projects 1-7 and their delivery time during phase 1. For further details, see Section 2.

<table>
<thead>
<tr>
<th>Deliverable</th>
<th>Name</th>
<th>Due month</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1-D1</td>
<td>A report of main aspects and indicators to the programme that will give support to the further work.</td>
<td>10</td>
<td>Delivered</td>
</tr>
<tr>
<td>P1-D2</td>
<td>A report dealing with the initial conceptual model.</td>
<td>12</td>
<td>Delivered</td>
</tr>
<tr>
<td>P1-D3</td>
<td>A seminar presenting results of conceptual modelling and indicator identification and construction work.</td>
<td>12</td>
<td>Delivered</td>
</tr>
<tr>
<td>P1-D4</td>
<td>A research paper discussing the multiple perspectives of importance for managing chemicals together with some initial findings.</td>
<td>15</td>
<td>Delayed</td>
</tr>
<tr>
<td>P1-D5</td>
<td>Literature survey of models</td>
<td>-</td>
<td>Bonus report, Delivered</td>
</tr>
<tr>
<td>P2-D1</td>
<td>A workshop to discuss the identification and prioritization procedure.</td>
<td>8</td>
<td>Delivered</td>
</tr>
<tr>
<td>P2-D2</td>
<td>A report on the initial procedure for identification of chemical/article/use combinations of concern, including the selected case-study chemicals</td>
<td>12</td>
<td>Delivered</td>
</tr>
<tr>
<td>P2-D4</td>
<td>The Omnitox tool implementation report</td>
<td>12</td>
<td>Delivered</td>
</tr>
<tr>
<td>P3-D3</td>
<td>Review of existing data on compounds accumulating in vertebrates at higher trophic levels, i.e. predators among fish, birds and mammals</td>
<td>27</td>
<td>Delivered</td>
</tr>
<tr>
<td>P3-D4</td>
<td>Review of existing data on compounds accumulating in human milk, adipose tissue and blood</td>
<td>27</td>
<td>Rescheduled to month 36</td>
</tr>
<tr>
<td>P4-D1</td>
<td>A report on the general procedure for quantification of organic emissions from articles.</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>P4-D3a</td>
<td>PVC-golv och metodik för varuflöden (PVC-flooring and method for article flows)</td>
<td>-</td>
<td>Bonus report, Delivered</td>
</tr>
<tr>
<td>P4-D4</td>
<td>A report on current and future flows of organic chemicals from articles on a National level</td>
<td>24</td>
<td>Rescheduled to month 30</td>
</tr>
<tr>
<td>P5-D1</td>
<td>Emission inventories of different source categories on a local (urban) and national scale</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>P6-D1</td>
<td>A report on the results of the investigation on how the risks with chemicals in articles are perceived among relevant actors.</td>
<td>24</td>
<td>Rescheduled to month 36</td>
</tr>
<tr>
<td>P6-D2</td>
<td>A report on the results of the investigation on how different risk communication forms and pathways affect the perception of actors</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>P7-D4</td>
<td>Case-study Building industry. Problem reduction strategies and the interaction between policy-makers and industry. A report of the pre-study for the building sector</td>
<td>24</td>
<td>Delivered</td>
</tr>
<tr>
<td>P7-D5</td>
<td>Case-study Green-Chemistry. Problem reduction strategies for innovative processes.</td>
<td>36</td>
<td>Rescheduled to month 42</td>
</tr>
</tbody>
</table>
6 Co-funding and networks

Several projects in ChEmiTecs are or will be directly co-funded through other sources:

- Project 1, on problem framing, concepts and indicators, has benefited from the collaboration with the FORMAS-funded project InFlow, regarding the information flow aspect of the problem of chemicals in products.

- Project 3, Development of oxidation, reduction and HSE reactions for potential environmental contaminants was directly co-funded by FORMAS during a period of ChEmiTecs.

- Project 4, on emission measurement, modelling, and quantification, benefits from analytical expertise and methodologies spawn within the MistraPharma project and, directly, from method development efforts within the Swedish EPA screening projects on Benzothiazoles and Benzotriazoles.

- Project 5, on relative importance of emissions from articles benefits from a number of screening studies carried out within the Swedish EPA screening program especially the ongoing screening on Benzothiazoles and Benzotriazoles with direct link to ChEmiTecs.

- Project 7, regarding problem reduction strategies (Deliverable P7-D4), has benefited from external co-financing by the Foundation for the Swedish Environmental Research Institute (SIVL) and the building industry.

ChEmiTecs contributes to, and benefits from, a number of concurrent projects, with which we collaborate:

- TOSUWAMA is the Swedish National research program on sustainable waste management. ChEmiTecs collaborates with the Tosuwama programme regarding hazardous substances emissions from waste management practices. First, ChEmiTecs Project P5 works together with Tosuwama on Substance Flow Analyses for selected product- and waste flows containing relevant substances. Second, ChEmiTecs Project P4 investigates to what extent the waste stream flows in the Tosuwama National LCA model can be used as basis for the ChEmiTecs estimate of emissions of hazardous substances, and complement that model. (Partner: IVL/Rydberg; Chalmers/Tivander)

- SMED (Swedish Environmental Emissions Data) is a collaborative consortium, formed in 2001 involving four organisations (IVL, SCB, SLU, SMHI). The primary aim is to gather and develop Swedish competence within emission statistics related to the national abatement efforts within the areas emissions to air and water, waste/waste management, and hazardous substances/toxic chemicals. SMED was awarded a nine-year contract (2006-2014) for the Swedish Environmental Protection Agency to deliver all required data and associated information for Sweden's international reporting obligations concerning emissions to air and water, waste and hazardous substances. Naturally, all activities within SMED relating to emissions of organic chemicals are of relevance to ChEmiTecs. (Partner: IVL/Brorström-Lundén & Palm Cousins)

- RISKCYCLE is a Coordination Action in EU FP7, carrying out state-of-the art and research needs analyses regarding Chemicals risks related to the potential distribution and emissions of hazardous substances such as additives in a material-recycling intensive economy. (Partner: IVL/Rydberg)
• COHIBA - Control of hazardous substances in the Baltic Sea region is a three-year-programme (2009-2012), financed by the European Union within the Baltic Sea Region Programme 2007-2013. The Project aims to identify the sources and inputs of 11 hazardous substances, prioritized under the Baltic Sea Action Plan (BSAP). Furthermore, possibilities to implement measures to reduce emissions of these substances will be identified and thereby the implementation of the BSAP with regard to hazardous substances will be supported. All Baltic countries are partners with the exception of Russia and Belarus, and the Swedish partners are IVL, KemI and Miljöförvaltningen Stockholm. (Partner: IVL/Brorström-Lundén & Palm Cousins)

• CADASTER is a research project in FP7, with IVL as a key participant. The programme aims at providing practical guidance to integrated risk assessment by carrying out a full hazard and risk assessment for chemicals belonging to four compound classes. QSAR models will be developed, validated, and used to predict data for chemicals of four selected classes. These data will be used for hazard and risk assessment, when experimental data are lacking. The main goal is to exemplify the integration of information, models and strategies for carrying out safety-, hazard- and risk assessments for large numbers of substances. CADASTER will show how to increase the use of non-testing information for regulatory decision whilst meeting the main challenge of quantifying and reducing uncertainty. CADASTER has selected tribenzothiazoles as one key substance, which are also part of one of the ChEmiTecs case studies. (Partner: IVL/Palm Cousins)

• Swedish EPA conduct annual sludge screening and several compound class specific screening campaigns targeting organophosphate esters, perfluorinated compounds, and phthalate esters. (Partner: UmU/Haglund)

• MCN (Northern Sweden Soil Remediation Center) is a competence centre within soil science, remediation, mobility modelling, and risk assessment. It involve four core partners Umeå University, Luleå Technical University, Swedish Defence Research Agency, and the Swedish University of Agricultural Sciences and 18 associated national and international partners. (Partner: UmU/Haglund)

• EU Joint Research Centre (JRC)-Ispra coordinates a sampling and analysis campaign on waste water treatment plant effluent and sludge, which will contribute with organic pollutant fluxes to the aqueous environments and soil (through use of sludge as fertilizer). UmU and Swedish EPA are active partners in this pan-European consortium. (Partner: UmU/Haglund)

• FORMAS “BåtRisk” concerns the process of regulatory risk assessment and management of a particular group of articles namely biocides. This project has relevance for ChEmiTecs projects 6 and 7. (Partner: KTH/Wester and Rudén)

• FORMAS “Fass.se” concerns voluntary initiatives to disseminate information about environmental risks with the purpose of risk management. This project has relevance for ChEmiTecs project 7. (Partner: KTH/Rudén)

• FORMAS “Bisphenol A” concerns lay people perception of chemical risks associated with consumer goods. This project has relevance for ChEmiTecs project 6. (Partner: KTH/Wester and Rudén)

• FORMAS "Towards Improved Interactions in the Two-Way Flow of Risk-Related Chemical Information -- The Cases of Clothing, Toys, and Paint", (InFlow), financed by Formas, has provided significant input to ChEmiTecs. The InFlow-project studies the information flows in supply chains, a relevant aspect of the problem. Staff working in the InFlow-project has also actively participated in the programme, especially in reference group meetings. (Partner: Chalmers/Molander)
• VR “QSARs and other non-testing instruments to reduce animal tests: From science to regulatory decisions” concerns the use and development of various modelling tools for use in risk assessment of chemicals. This project has relevance for projects 2 and 3 for assessing the potential risks of chemicals in goods. (Partners: KTH/Rudén and UmU/Andersson)

• Mistra Urban Futures is a new centre for sustainable urban development, based in Gothenburg. The core of the centre activities is trans-disciplinary knowledge production aiming at sustainable urban development. Five pilot projects in Gothenburg will begin in 2010. Of these, one is "Business-driven sustainable development enhancing innovation and entrepreneurship", and builds on previous experiences including the Green Chemistry project (2000-2006).
7 Plan for Phase 2

The work in Phase 2 of ChEmiTecs contains the following main areas of work:

- Refinement, further elaboration including empirical studies, further development and application of the model to quantify emissions from materials and articles
- Assessment of the significance of the emissions and the options to reduce problems related to these emissions
- Completion of the individual projects and overall integration, synthesis and communication of the research carried out

This is in line with the original plan. However, in the currently presented plan, some modifications have been introduced. In particular, an increased emphasis will be put on the quantification of emissions.

The time plan, Table 9, will largely remain as originally planned for years 4-5. Small adjustments within individual projects and regarding management and communication events are outlined below.

<table>
<thead>
<tr>
<th>Major activity level</th>
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</thead>
<tbody>
<tr>
<td>A Programme researcher's meeting (General assembly)</td>
</tr>
<tr>
<td>B Externally oriented conference/workshop (reference group/open)</td>
</tr>
<tr>
<td>C Programme Coordination team meeting (coordinated with A)</td>
</tr>
<tr>
<td>D Programme Management Committee meeting</td>
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<table>
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<th>Minor activity level</th>
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<tr>
<td>A Programme researcher's meeting (General assembly)</td>
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<td>B Externally oriented conference/workshop (reference group/open)</td>
</tr>
<tr>
<td>C Programme Coordination team meeting (coordinated with A)</td>
</tr>
<tr>
<td>D Programme Management Committee meeting</td>
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Table 9 Time plan for Years 4-5 of the ChEmiTecs programme.

<table>
<thead>
<tr>
<th>Project No</th>
<th>Project short name</th>
<th>Programme year</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
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<td></td>
<td>Calendar year</td>
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<td>Q2</td>
</tr>
<tr>
<td></td>
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<td></td>
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<td></td>
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<td>Framework &amp; indicators</td>
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<td>3</td>
<td>Chemical Stability</td>
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<tr>
<td>4</td>
<td>Quantification of emissions</td>
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<td></td>
</tr>
<tr>
<td>5</td>
<td>Relative Importance</td>
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<td></td>
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<td>6</td>
<td>Problem perception</td>
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<tr>
<td>7</td>
<td>Problem reduction strategies</td>
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<tr>
<td>8</td>
<td>Operationalisation / Synthesis</td>
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<td>A</td>
<td>B</td>
<td>A</td>
</tr>
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<td>Programme co-ordination</td>
<td>C</td>
<td>D</td>
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</table>
7.1 Short review of plan for each project

As the projects largely will run according to plan, this section provides a very short resume of each project plan for Phase 2, also detailing where there are modifications compared to the original plan.

Project 1

Project 1 has been completed. Results from Project 1 form an important basis for the work in Project 8, where problem reduction measures and related indicators will be assessed and elaborated as part of the forward-looking synthesis.

Project 2

Project 2 on selection of case studies is close to completion. The knowledge and data gained in Project 2 will also be used in other projects during Phase 2, e.g. chemical property data will be used in Projects 4 and 5. The results from the Swedish EPA funded screening programme for 2009 are expected during 2010 and will be used for a final decision of the case study chemicals (benzothiazole and benzotriazole), where so far no definite decision has been taken. The expected deliverable will be completed after these results are available:

- P2-D3: A report on the final identification procedure (of chemical/article/use combinations of concern)

Project 3

The continued method work will shift slightly towards exploring the opportunities to predict persistence of selected chemicals related to articles rather than to further develop the reactivity methodology to include potential for bioaccumulation, although this latter approach is still part of the research development within P3. Further, experimental protocols on persistence assessment are now available for chemical oxidative reactivity, hydrolysis, photolysis, and reductive reactivity. Data based on these tests will be generated for some case study chemicals. Additional data on persistence will be searched in the literature to reach a more complete picture on the chemical stability and fate of the case study chemicals. This will feed into the overall assessment of the significance of emissions, e.g. the fate modelling in Project 5. In line with the original plan, the following deliverables will be obtained in Phase 2. Of these, P3-D5 will also contain results from the survey in scientific literature on occurrence of case study chemicals in the environment, as indicated in Section 2.

- P3-D1: Development of a method for identification of chemical stability to promote assessment of the chemical persistence of a compound
- P3-D2: Report on the application of the reactivity approach on assessing chemicals being bioaccumulative
- P3-D5 Report on the (eco-)toxicity of prioritized compounds as related to guideline data
Project 4

Project 4 is a very central project in the programme as it deals with the quantified estimate of emissions from articles. This focus was also emphasized in the original process of granting the programme, when the Swedish EPA requested from the consortium a further description and clarification of the procedure to achieve the emission quantification on the National level. Such a clarification was submitted (Appendix 1) and approved. This procedure has now been integrated into the work flow of Project 4 as described here. As discussed with the Programme Management Committee in September 2009, the time schedule for the National emission quantification has been revised which schedules two iterations of National emissions estimate rather than one as was originally foreseen. A first rough emission estimate has been achieved in Programme month 31 (June 2010 - P4-D4), and a second, refined and expanded in scope, National emissions estimate is now scheduled as a new deliverable for month 54 (P4-D6). The other planned deliverables will be produced as scheduled, but with some minor adjustment of time plans (Table 10). This means that the following deliverables are now scheduled for Project 4 in Phase 2:

- P4-D2: A report on the bioavailability methodology
- P4-D3: A report on the emissions of case-study chemicals
- P4-D5: A generic model and prototype tool for predicting emissions of organic chemicals from articles
- P4-D6: A report on the results of the Generic model, including estimates of annual emissions of organic chemicals from articles.

In P4-D2 the emission mechanisms for organic chemicals from articles will be related to the distribution mechanisms of the primary recipient which subsequently will lead to a bioavailable fraction of the emission. The work relates closely to, and will feed into, P5-D4. The report P4-D3 will contain the detailed results of the assessment of emission characteristics of the case study chemicals. This detailed work will be important as knowledge base and model calibration for the final, generic emission model which will be described in detail in P4-D5, and which will be applied on the National stock of articles to be reported on in P4-D6.

Project 5

Project 5 complements Project 4, in that it puts the emissions estimated in Project 4 in relation to other burdens on the environment. This means that the time plan will be slightly compressed with respect to the slightly modified time schedule for Project 4, but the final deliverables of Project 5 were planned fairly late in the programme and the original delivery times will be met:

- P5-D2: A report on evaluation of the environmental occurrence for the case-study chemicals using data from literature, monitoring and screening studies
- P5-D3: A report on LCIA characterisation factors for substances used in the National assessment
- P5-D4: A report on the relative importance of emissions of se study chemicals from articles in relation to other sources and pathways on a local and national scale
- P5-D5: Report on Sampling strategies for monitoring of diffusive spread of chemicals
P5-D2 is a compilation and evaluation of available literature, screening and monitoring data for the case study chemicals, with input also from P3-D5, and with special emphasis on the environmental occurrence in the Stockholm area and Sweden. It forms the foundation to link measured and modelled article emissions (P4-D3 and P5-D1) to observed levels in the environment, and provides a basis of evaluation if estimated emissions are within reason. Screening studies for some case-study chemicals to fill data gaps, have been partly financed by the Swedish National screening programme. P5-D3 illustrates the application of the recently launched harmonized tool for Life Cycle Impact Assessment USETox to emissions quantified within the ChEmiTecs programme. The USETox model combines chemical fate and exposure models to assess relative risks for chemicals at different end-points in a generic environment. Here, input from Project 3 regarding (eco)toxicity for the case study chemicals will be useful. USETox builds on the same knowledge base as Omnistox, which was intended to be used in the original plan, but USETox has been further developed and already contains data for about 3000 chemicals. As a result, this tool should facilitate more advanced progress, requiring fewer resources, and therefore enables reallocation of refinement to refinement of the emission modelling. P5-D4 will, as originally planned, apply a fate model for case-study chemicals, thus linking emissions (P4-D3, P5-D1) and the concentrations found in the environment (P5-D2), which is a way to empirically validate the emission model developed in P4. P5-D5, as intended, is a brief report discussing different strategies for sampling and measuring chemicals diffusively emitted from articles.

**Project 6**

As indicated in Section 2, the work relating to the final deliverable in Project 6 runs according to plan. The empirical base gained by the surveys in Phase 1 will be elaborated further during Phase 2 to accomplish the third and final deliverable of the Project:

- **P6-D3**: A report on the results of the investigation on how the risk perceptions of various actors affect their behaviour towards risk reduction

**Project 7**

Part of the work in Project 7 is carried out by means of co-funding with other projects. Deliverable P7-D5 relating to innovation and Green Chemistry has therefore been delayed (See section 2), but will start during fall 2010. The deliverables for Project 7 in Phase 2 will therefore be:

- **P7-D1**: Report on actual effect of the chemicals legislation to promote the safe use of chemicals/articles for several of the substances of concern
- **P7-D2**: Report on the strengths and weaknesses of the objective A non-toxic environment as a means to promote risk management
- **P7-D3**: Report on strategies for voluntary means for problem reduction of emissions of organic substances from articles.
- **P7-D5**: Case-study Green-Chemistry. Problem reduction strategies for innovative processes.

The assessment of legislation (P7-D1) will cover how chemicals are regulated in different product legislation (See section 2) but it will also look further at how chemicals in products are dealt with in legislation along the value chain. The latter aspect is a refinement compared to our original plan. So two papers will be authored within P7-D1:
a) Different strategies for regulating risks associated with hazardous chemicals in articles within the European Union, in preparation
b) A report on the relations between different legislations covering different parts of a product’s life cycle (e.g. WFD, waste directive, sludge directive, CLP, REACH, RoHS, Toys Directive, and Directive for Medical Devices).

The deliverable P7-D2 builds much on the surveys that were developed in collaboration with Project 6, and will continue as planned.

Voluntary means such as labelling or product information/declarations, avoiding/replacing hazardous substances, product declarations (P7-D3) are applied to minimise risks, e.g. be prepared for-ahead of future legislation, and to increase competitiveness, e.g. fulfill customer requirements, and will be looked at from several perspectives. Here, three separate papers will be authored:
a) A paper evaluating existing voluntary schemes for the phase-out of dangerous substances in articles, e.g. BASTA, GADSL, HERA
b) A paper comparing systems for environmental classification and information dissemination
c) A paper on the Substitution Principle

Finally, P7-D5 will result in a paper outlining and elaborating the concepts of and conditions for Business Driven Sustainable Development (BDSD) with chemicals in products as empirical examples, and will be developed in close collaboration and partly integrated with a recently started pilot project (Ekberg et al, 2010) within Mistra Urban Futures (see Section 6).

**Project 8**

The overarching purpose of Project 8 is to bring together the research conducted throughout the Programme by pointing out potential ways forward starting from the knowledge base achieved in Projects 1-7 and performing an overall scientific synthesis of the Programme. Although a small activity was started in phase 1, the main part of work Project 8 will be carried out in phase 2, with the following deliverables:

- P8-D1: Synthesis report (Book in the form of an anthology, main deliverable)
- P8-D2: A report on the structural and organizational conditions for maintenance of indicators
- P8-D3: Strategy document containing Scenarios and Road maps towards a Non-toxic environment

The Scientific synthesis report (P8-D1) will analyse and summarise the research carried out in the programme as outlined already in the original plan, tentatively also contain an international outlook. A major part of the work in Project 8 will be devoted to this deliverable. The synthesis is intended to be written in the form of a book (anthology) with contributions from all partners. A tentative outline is attached in Appendix 4. One option to be investigated is to invite also external authors to contribute to the book.

The report on Conditions for Indicator implementation and the document on Scenarios and Road maps will be developed in a joint work process with a significant share of Stakeholder interaction in the form of workshops, interviews, etc, bringing the work done in Project 1 further with input from the knowledge gained in all projects. Thus a manageable number of problem reduction measures and related indicators (tentatively 3-
6) will be selected based on brief assessments (by means of e.g. Qualitative CBA, see Pacyna et al, 2008) of their feasibility and further elaborated with respect to: a) the conditions for setup and maintenance of indicators (P8-D2) and b) potential ways forward (roadmaps) under different circumstances (scenarios) (P8-D3). This integrated work approach will allow some budget reallocation to the emission modelling and quantification in Project 4.

7.2 Programme communication
The communication activities will be slightly expanded in Phase 2 compared to Phase 1, as more and more results are delivered from the research in the programme. Already in Phase 1, the programme has gained a lot of interest nationally as well as internationally. In Phase 2, results will increasingly be presented and communicated internationally, e.g. at scientific conferences and by peer reviewed publications. In addition to the Project-specific deliverables planned for Phase 2 (listed in Table 10) several communication activities common to the programme are planned. These are summarised in Table 11 and are largely in accordance with the original plan. An important update compared to the original plan is the intention to have the final conference aiming also at an international audience.

7.3 Programme management and budget
The programme-internal Coordination team will convene twice a year, and will consist of one member with a deputy per partner. The Programme Management Committee (i.e. the Coordination team plus external stakeholder representatives), will convene once a year also during Phase 2, as intended.

The budget for Phase 2 is distributed as shown in Table 12. There are some modifications compared to the originally planned budget for Phase 2, as indicated in Table 13. The main difference is related to the increased focus to deliver high quality results in Project 4. Another difference is the minor reallocation of budget for management and travel between the partners. The specific proposed changes are as follows:

1) The budget for Project 4 is increased by 1215 kSEK. This will be accomplished by the following means:
   a) IVL reallocates 200 kSEK from Project 5 and 100 kSEK from management activities
   b) Chalmers reallocates 47 kSEK from Project 2, 188 kSEK from Project 5, and 300 kSEK from Project 8
   c) UmU reallocates 130 kSEK from Project 5 and 250 kSEK from Project 2.

The reduction of budget for Project 5 is made possible as the screening activities originally foreseen within P5-D2 has partly been accomplished by external funding in the National Swedish Screening programme for 2009. Also, the choice to implement USEtox rather than Omnitox in P5-D3 reduces resource needs for this activity, which allows Chalmers to focus on Project 4. The shift of budget from Project 2 to Project 4 is made possible as the selection procedure and the description of it has been almost finalised already in Phase 1. The transfer of budget from Project 8 to Project 1 is made possible by the integrated work process of P8-D2 and P8-D3.
2) Project meetings are planned to be held predominantly in Stockholm, as was the case also in Phase 1. Therefore it is judged reasonable to reallocate some budget from the Stockholm-based partners (IVL, KTH and SU) to Chalmers and UmU. As a result, 30 kSEK is reallocated from KTH to Chalmers and 30 kSEK from SU to Umeå. An additional 50 kSEK is reallocated from IVL to UmU.
Table 10 Full list of deliverables planned for Phase 2 of ChEmiTecs.

<table>
<thead>
<tr>
<th>Deliverables</th>
<th>Original month</th>
<th>Revised month</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2-D3: A report on the final identification procedure (of chemical/article/use combinations of concern)</td>
<td>48</td>
<td>48</td>
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</tr>
<tr>
<td><strong>Project 3</strong></td>
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<tr>
<td>P3-D1: Development of a method for identification of chemical stability to promote assessment of the chemical persistence of a compound</td>
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<td>P3-D2: Report on the application of the reactivity approach on assessing chemicals being bioaccumulative</td>
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<tr>
<td>P3-D5: Report on the (eco-)toxicity of prioritized compounds as related to guideline data</td>
<td>37</td>
<td>37</td>
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<tr>
<td><strong>Project 4</strong></td>
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<td></td>
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<tr>
<td>P4-D1: A report on the general procedure for quantification of organic emissions from articles.</td>
<td>36</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>P4-D2: A report on the bioavailability methodology.</td>
<td>42</td>
<td>42</td>
<td></td>
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<tr>
<td>P4-D3: A report on the emissions of case-study chemicals.</td>
<td>48</td>
<td>54</td>
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<tr>
<td>P4-D5: A generic model and prototype tool for predicting emissions of organic chemicals from articles.</td>
<td>40</td>
<td>48</td>
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<td>P4-D6: A report on the results of the Generic model, including estimates of annual emissions of organic chemicals from articles.</td>
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<tr>
<td>P5-D1: Emission inventories of different source categories on a local (urban) and national scale</td>
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<td>36</td>
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<tr>
<td>P5-D2: A report on evaluation of the environmental occurrence for the case-study chemicals using data from literature, monitoring and screening studies</td>
<td>48</td>
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<td>P5-D3: A report on the application of LCIA methodology to evaluate risks associated with chemicals emitted from articles</td>
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<tr>
<td>P5-D4: A report on the relative importance of emissions of case-study chemicals from articles in relation to other sources and pathways on a local and national scale.</td>
<td>54</td>
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<tr>
<td>P5-D5: Report on Sampling strategies for monitoring of chemicals diffusively emitted via articles.</td>
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<td><strong>Project 6</strong></td>
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<tr>
<td>P6-D3: A report on the results of the investigation regarding how various actors’ risk perceptions affect their behaviour towards risk reduction</td>
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<td><strong>Project 7</strong></td>
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<td>P7-D2: Report on the strengths and weaknesses of the objective A non-toxic environment as a means to promote risk management.</td>
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<td>P7-D3: Report on strategies for voluntary means for problem reduction of emissions of organic substances from articles.</td>
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<td>P7-D5: Case-study Green-Chemistry. Problem reduction strategies for innovative processes.</td>
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<tr>
<td><strong>P8-D1</strong></td>
<td>Scientific synthesis report</td>
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<td>57</td>
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<td><strong>P8-D2</strong></td>
<td>A survey of structural and organizational conditions for setup and maintenance of indicators</td>
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<td><strong>P8-D3</strong></td>
<td>Strategy document containing Scenarios and Road maps towards a Non-toxic environment</td>
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<p>| Table 11: Planned communication activities in phase 2 of ChEmiTecs. |
|-------------------|-------------------|-------------------|-------------------|
| <strong>Communication product</strong> | <strong>Schedule according to original plan</strong> | <strong>Comment</strong> |
| <strong>Meetings</strong> | | |
| General assembly of programme researchers | Programme meeting, 2 times per year | 2 times per year |
| Programme management meeting | 2 times per year | Management committee meeting 1 time/year Coordination team meeting 2 times/year |
| Stakeholder meeting (Reference group) | 1 time per year | One separate meeting and one combined with final conference |
| Project related meetings with external actors | As planned in each project | In Phase 2, especially Project 8 encompasses 2-3 stakeholder workshops |
| Final conference | Programme workshop at end of programme | Will aim at an international audience |
| Professional training | End of programme | Workshop or seminar with market stakeholders and policy makers etc. |
| <strong>Other</strong> | | |
| Webpage (in Swedish, and English) | Start beginning of the programme, regular updating | Regular update, approximately once a month, or on a needs basis |
| Internal webpage | Start beginning of the programme, regular updating | Regular update, approximately once a month, or on a needs basis |
| Progress report | Yearly | Was completed for 2008 but will be replaced by the overall reporting for extension of the project for years 4-5 during 2010. |
| Final report | End of programme | Administrative report. The scientific final report is the Synthesis Book (P8-D1) |
| Communication plan | Year 1, thereafter updated when needed | This table is the main update. Further changes in communication activities may be decided in the Coordination team |
| Press releases | When launching the programme, thereafter when appropriate | Will be issued when important reports are published, as decided by the Coordination team |
| Presentation material (information leaflet, PowerPoint presentation material) | Year 1, thereafter updated when needed | Is available on the internal website. Will be updated in relation to communication events as appropriate. |
| Newsletter (electronic) | Every 6 months | Will be issued on decision by the Coordination team |
| Deliverables (Technical reports, papers, workshop reports, etc) | According to deliverable list | See Table 10 |</p>
<table>
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<tr>
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<th>KTH</th>
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<th>Chalmers</th>
<th>KTH</th>
<th>SU</th>
<th>UMU</th>
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9 Appendices

1. "Project XI: National Emissions Inventory" - Refined description of method and expected results
2. List of Publications and Presentations from ChEmiTecs
3.1 ChEmiTecs - Consumer survey / Konsumentenkät (items only; in Swedish)
3.2 ChEmiTecs - Producer survey / Producentenkät (items only; in Swedish)
4. Tentative Book Table-of-Content
ChEmiTecs Mid-term report - Appendix 1:

XI. National Emissions Inventory (sub-project of Projects #2, #4 and #5)

Project manager
Tomas Rydberg, PhD, IVL Swedish Environmental Research Institute, Box 5302, S-400 14 Göteborg, +46-31 725 62 63, tomas.rydberg@ivl.se

Abstract
This description clarifies how the inventory of emissions to the environment of organic substances from products and articles in the technosphere will be carried out in the programme.

In this project we will take an inventory of emissions of organic compounds from materials and articles, based on information on product flows, product composition and structure, content of organic chemicals relevant to the programme, as well as use patterns and waste management. A generic model for emissions of organic substances from articles will also be applied to fill data gaps. The model will also provide an estimate how these emissions can be expected to change over the next approximately 20 years.

Aim of project
The project aims to compile an inventory as complete as possible about the emissions of organic chemicals from articles. The project is partly integrated with, and beyond that builds on, the conceptual model activity of project #1, the systematic selection procedure in project # 2, and the generic emission model in project # 4, to compile the inventory of "National article related emissions" in project # 4.

Theory and methods - National article related emissions
Generic (Conceptual) Model (Initial Activity of Project # 2, "2a", draft version in Project # 1)
The amount of emissions from articles is conceptually determined by, among other: a) physico-chemical properties of the substances, b) the material in which it is contained, c) structure of the product (e.g. bulky or high surface area) d) the use and waste management characteristics, external conditions, temperature, humidity, UV radiation, etc. (Figure XI:1). A model of this conceptual structure will be one of the methods to determine nation-wide emissions of organic substances from articles, and is also applied in the selection procedure described in project # 2. The procedure will point at some chemical/article/life cycle combinations to be further studied in greater detail in subsequent activities in project # 4. these detailed studies will be useful to verify the model by comparing model and detailed study results for he selected combinations. The model will be refined in project # 4 and combined with information as that described in the sections below to achieve the National inventory.
These concepts are all necessary but not sufficient components of the cause-effect chains leading to a significant release of chemical substances of concern leading to effects on humans and the environment.

Figure XI:1 Main conceptual elements determining the emissions of organic substances from products in the technosphere

Nation-wide product flow
A main task in the programme is to find information on the nation-wide flow of articles. Moreover, it will be a challenge to calculate or estimate the stock of products in society. In a typical system analysis mode of action, such as in material flow analysis and life cycle assessment, iterations starting with available information and estimates, and gradually refining information quality by additional data collection will be carried out. For certain product groups, e.g., vehicles, sales statistics can be found comparatively easily (BilSweden, 2007), and product life time, product composition, and end-of-life practices are reasonably well known (e.g., Schmidt, W.-P., et al., 2004). For other groups, e.g., home appliances and electronics as well as building materials, previous LCAs and similar studies containing composition information (e.g., Eriksson, 2006), and also sales statistics is largely available and can be used as starting point. Similarly, for certain other groups, e.g., toys, available sales statistics will be used as starting point. To a certain extent and at least initially, qualified estimates by sector experts will be necessary. A main challenge and hard work will be to make use of available information, while achieving sufficient details regarding product composition and organic substance content. Here the network of industrial partners in the programme is expected to be of help.

Chemicals emissions from flows and stock of products
For substances that are present in materials or articles with an expected long lifespan it will be essential to calculate the accumulated amount of the substance, and time-dependent emission factors. A method for this has previously been developed within SMED (Svenska MiljöEmissionsData; a collaborative effort between IVL, Statistics Sweden and SEPA). It uses
information on emission factors, current and previous sales volumes and the expected product half-life to calculate the annual emission of the compound under study (Palm et al 2005). Compilation of emission factors, from literature and experiments, is a main task of project # 4, and will feed into the National inventory.

**Input/Output tables - a support method**

Input/output tables (I/O) basically aggregate and tabulate economic flows between economic sectors, but recent adaptations to allow environmental assessments and priority setting among products have been developed in Europe (Eder et al, 2006) and have been investigated for Sweden as well (Finnveden et al, 2007).

The I/O-method is useful as it is complete in the sense that the whole economy is covered in principle. Therefore it has been used in the context of Life cycle assessment to safeguard completeness in the coverage of the background system (i.e. parts of the product system for which rather rough information is good enough). Unfortunately the method is rather imprecise in estimating product flows, and consequently also on estimates of organic chemical in these products. But similar to the LCA use, the approach will be investigated as complementary information source and for cross-comparisons.

**Future product flows over time**

In order to estimate National scale future development of the emissions of organic chemicals from articles, a model will be developed in a collaborative project with the research programme Sustainable Waste Management (Ekvall et al 2006). In Project 7 of that Waste Research Programme, future waste flows in about 30 categories will be estimated based on the EMEC model (Environmental Medium Term Economic Model) of the Swedish Institute for Economic Research (Östblom 1999; Östblom & Berg, 2006). In the current programme we will further build on the results of the "EMEC-Waste" model and add composition information on organic chemicals in these categories to be able also to estimate future emissions of organic chemicals.

**Staff**

Staff at Chalmers, IVL.

**Deliverables**

The following main deliverable from the project is:

- P4-D4: A report on the results of the National scale and future flow inventory analysis.

The output from this activity is also closely linked to or building on other deliverables within the programme:

- P2-D1, P2-D2 and P2-D3: Deliverables on the integrated identification procedure
- P4-D5: A generic model and prototype tool for predicting emissions of organic chemicals from articles

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BilSweden, 2007: http://www.bilsweden.se/bilforsaljningen_i_siffror.asp

Ekvall et al, Towards Sustainable Waste Management, IVL Swedish Environmental Research Institute, Research Plan to The Swedish Environmental protection agency, 2006.


Finnveden G., Anders Wadeskog, Tomas Ekvall, Rebecka Engström, Olof Hjelm och Viveka Palm. Miljödata för produktgrupper – användning av Input-Output-analyser i miljösystemanalytiska verktyg
ChEmiTecs Mid-term report - Appendix 2:

Publications and presentations from ChEmiTecs

This compilation contains publications to which researchers in ChEmiTecs have contributed wholly or partly as part of work done within the programme. Publications and presentations in the following categories are included in the compilation:

- ChEmiTecs Reports
- Scientific articles (& Manuscripts)
- Abstracts /Conference contributions
- Theses
- Other reports (Diploma works etc)
- Popular science articles
- Oral presentations

Overall programme


Rydberg, T., Screening in relation to goods and material flows, presentation at the seminar "Screening and environmental toxics", Swedish Environmental Protection Agency & IVL Kunskap, Göteborg, June 3-4, 2008 (in Swedish).

Rydberg, T., Emissions from articles – what is the magnitude of the problem (& what can be done about it), presentation at SNMM (Svenskt-Norskt Miljökemiskt Möte), Sigtuna, September 22, 2008.

Rydberg T, När varan läcker, presentation at Plast- & Kemiföretagens kemikaliedagar, Båstad, October 2, 2008 (in Swedish).


Fischer, S., Emission from Articles and Service Life: "ChEmiTecs" - A Swedish research programme on emissions from articles, presentation at the 16th Meeting of the Task Force on Environmental Exposure Assessment, OECD, Dessau - Rosslau, Germany, October 08-09, 2008.
Rydberg, T., Forskningsprogrammet ”Emissioner från varor”, presentation at ”Substitution av kemikalier”, seminar organised by the National substitution group, Stockholm, April 21, 2009 (in Swedish).

Rydberg, T., ChEmiTecs: Swedish research programme on release from articles, presentation at the First meeting of the Task Force on Exposure Assessment, OECD, Paris, November 30 - December 1, 2009.


Project 1


Molander S, Kemikalier i varor, Presentation of the ChEmiTecs & InFlow projects at Seminar arranged by KemI, SAS Radisson Hotel Göteborg, November 27, 2008.


Project 2

Andersson, P., Multivariate characterisation of industrial chemicals and strategies to identify potential environmental pollutants. Platform presentation, ICCE 2009, Stockholm, Sweden


Project 3


Bergman, Å., Prediktion av persistens och passiv bioackumulerbarhet. ChEmiTecs referensgruppsmöte, 2008-10-13, Ersta Konferenccenter. Stockholm

Bergman, Å., What matters? Views of environmental research stretching from basic organic chemistry to epidemiology. 2009-08-20, Tongji University, Shanghai


Granelli, L., Eriksson, J., Athanasiadou, M., Bergman, Å. Reductive debrominated diphenyl ethers by sodium borohydride and product identification, manuscript, 2010

Heimstad, E.S., Moreira Bastos, P., Eriksson, J., Bergman, Å., Harju, M. Quantitative structure – Photodegradation relationships of polybrominated diphenyl ethers, phenoxyphenols and selected organochlorines, Chemosphere, 2009, 77 (7), 914-921


Jörundsdottir H: Temporal and spatial trends of organohalogens in guillemot (Uria aalge) from North western Europe, Doctoral Thesis in Environmental Chemistry, Stockholm University, 2009


Moreira-Bastos, P: Comparison of experimentally and theoretically determined oxidation and photochemical transformation rates of some organohalogens to promote prediction of persistence, Doctoral Thesis in Environmental Chemistry, Stockholm University, 2009

Moreira Bastos, P., Eriksson J., and Bergman, Å., Photochemical decomposition of dissolved hydroxylated polybrominated diphenyl ethers under various aqueous conditions, Chemosphere, 2009, 77(6), 791-797

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Paulsson, B., Occurrence in the environment of case-study chemicals - A literature study, ChEmiTecs Interim Report P3-D5a-IR, June 2010, Stockholm University, Sweden. http://www.chemitecs.se/publikationer


Project 4


Rosenhall, J. Emissioner av benzothiazole ur bildäck och trifenylofas ur lcd-skärmar. i avfallshanteringsfasen, draft/ongoing work, 2010, in collaboration with the research programme Hållbar avfallshantering. Responsible partner: Chalmers/Tivander


**Project 5**


Einarson, E., Emissions from car tyres- method and application of environmental risk assessment for emissions from products, manuscript 2009 (in English)


Molander, S. LCA/LCIA and “nano”- a brief intro for the NanoFATE project, Presentation, NanoFATE workshop Seville, Spain, May 21, 2010

Nyholm JR, Lundberg C, Andersson PL. ”Biodegradation kinetics of brominated flame retardants in aerobic and anaerobic soil”. Accepted, Environmental Pollution, 2010.


**Project 6**

Wester, M and Eklund, B “’My husband usually makes those decisions’ – gender, behaviour and attitudes towards the marine environment”. Submitted manuscript [also financed from other sources than ChEmiTecs]

**Project 7**


Edvardsson Björnberg, K. 2009. What relations can hold among goals, and why does it matter? /Crítica, Revista Hispanoamericana de Filosofía/ 41(121), 47–66. [also financed from other sources than ChEmiTecs]

Edvardsson Björnberg, K. 2009. Rational goals for the urban environment: a Swedish example. /European Planning Studies/ 17(7), 1007–1027. [also financed from other sources than ChEmiTecs]

Edvardson Björnberg, K. 2008. Utopian goals: four objections and a tentative defence. /Philosophy in the Contemporary World/ 15(1), 138–153. [also financed from other sources than ChEmiTecs]


Rudén C. May 31, 2009 “Risk assessment for a sustainable chemical use – within REACH and beyond” Key Note presentation at the annual meeting of SETAC Europe in Göteborg. Invited speaker.

Ågerstrand, M and C Rudén “Accuracy and consistency of the Swedish Environmental Classification and Information System for pharmaceuticals” Accepted for publication in Science of the Total Environment (STOTEN). Prepublication copy available at: http://dx.doi.org/10.1016/j.scitotenv.2010.02.020 [also financed from other sources than ChEmiTecs]
ChEmiTecs Mid-term report - Appendix 3.1:

Consumer survey items

Chemitecs Konsumentenkät


I denna undersökning är vi intresserade av att undersöka hur konsumenter ser på och förhåller sig till kemikalier som ingår i olika produkter. Alla produkter och varor vi omges av innehåller kemikalier och vissa av dessa kan vara giftiga för människors hälsa och för naturen. En del kemikalier är mer farliga för naturen än för människors hälsa, och tvärtom, därför har vi valt att skilja på dessa två begrepp. Därför ställs frågor kring hälsorisker och miljörisker.

Denna undersökning är en del i ett större forskningsprogram som finansieras av Naturvårdsverket och är ett samarbete mellan olika universitet. Du hittar mer information om programmet här: www.chemitecs.se

Bakgrund

Kön

Ålder:
18-25
26-35
36-45
46-55
56-65
66 eller över

Barn:
Ja – bor hemma:
- Ålder på barnen: 0-5
Först generella frågor till alla:

   - Skor
   - Bildäck och de partiklar och kemikalier som frigörs från däcken när man använder bilen
   - Möbelklädsel och de ämnen som finns som ytbehandling på textilier
   - Elektronik, som en LCD-skärm
   - Golv, plast och laminat
   - Plaster som används i nappflaskor eller matlådor

2. Hur stor anser du att risken är för att ämnen som är skadliga för din hälsa kan frigöras från följande konsumentprodukter?
   - Skor
   - Bildäck
   - Ytbehandlade textilier
   - Elektronik
   - Golv, plast och laminatgolv
   - Plaster som i nappflaskor och matlådor
   - Glasprodukter

3. Hur stor anser du att risken är för att ämnen som är skadliga för din miljö kan frigöras från följande konsumentprodukter?
   - Skor
   - Bildäck
   - Ytbehandlade textilier
   - Elektronik
   - Golv, plast och laminat
   - Plaster som i nappflaskor och matlådor
   - Glasprodukter
   Skala: 1 (ingen risk) till 7 (stor risk)

Kunskap – produktsspecifik här kan bilderna komma in på en av de fem vi valt ut

4. I enlighet med det du vet, hur stor bedömer du risken vara för att farliga ämnen ska frigöras från denna typ av produkt och vara skadligt för din hälsa?
5. I enlighet med det du vet, hur stor bedömer du risken vara på en samhällsnivå, för andra människors hälsa?

6. I enlighet med det du vet, hur stor bedömer du risken vara för hälsan hos de människor som tillverkar dessa produkter?

7. I enlighet med det du vet, hur stor bedömer du risken vara för att kemikalier ska frigöras från denna typ av produkt och vara skadligt för miljön i Sverige?

8. I enlighet med det du vet, hur stor bedömer du risken för att kemikalier ska frigöras från denna typ av produkt och vara skadligt för miljön i det land där varan produceras?

9. I enlighet med det du vet, hur stor bedömer du risken för att kemikalier ska frigöras från denna typ av produkt och vara skadligt för miljön i ett globalt perspektiv?

Skala: 1 = Inte alls till 7 = I stor utsträckning

10. Om du köper någon av denna typ av produkt, i vilken utsträckning läser du den produktinformation som följer med?

1 = aldrig till 7 = alltid

11. Om du köper någon av denna typ av produkt, i vilken utsträckning kontrollerar du om den har någon märkning, till exempel en miljömärkning?

1 = aldrig till 7 = alltid

Information

Ta ställning till följande påståenden:

12. Producenterna gör så gott de kan för att få ut information om potentiella hälsorisker som deras produkter för hemmabruk kan medföra.

13. Producenterna gör så gott de kan för att få ut information om potentiella miljörisker som deras produkter för hemmabruk kan medföra.


15. Jag får tillräcklig information om potentiella miljörisker som de varor och produkter som jag köper för hemmabruk kan medföra.

16. Myndigheterna bör ta större ansvar för att se till att konsumenter får den information de behöver.

17. Det är konsumentens ansvar att se till att de varor man köper är säkra för hälsa och miljö.

1 = Instämmer inte till 7 = Instämmer helt

- Broschyrrer som följer med varan när jag köper den
- På tillverkaren eller återförsäljarens hemsida
- Genom telefonnummer till tillverkarens konsumentupplysning
- Genom Konsumentverket
- Genom den kommunala konsumentupplysningen
- Genom märkning på produkten
- Genom facktidningar
- Genom oberoende granskningsgrupper
- I dagspress
- Via TV
- Via radio
- I en innehållsförteckning på produkten
- Inte alls, det är producentens ansvar att produkten ska vara säker
- Annat __________
- Jag behöver ingen information

19. Vilka källor litar du mest på när det gäller information om kemikalier och deras egenskaper som ingår i produkter? *Här kan du ange fler än ett alternativ*

- Familj och vänner
- Svenska myndigheter
- Europeiska myndigheter
- Oberoende konsumentorganisationer
- Miljöorganisationer
- Forskare viduniversitet
- Producecenter
- Återförsäljare
- Min egen kunskap
- Annan ______________
- Ingen av dessa

**Märkning**

20. Ange vilket alternativ du anser är korrekt för följande märkningar:

![KRAV logo](image)

Denna märkning visar att:
Produkten är framställd på ett hållbart sätt genom hela producentkedjan
Produkten är framställd där minst en komponent som är framställd på ett hållbart sätt
Produkten är framställd på ett sätt som följer de krav som ställs inom europeisk kemikalehantering
Denna märkning visar att:
Produkten är kontrollerad av den europeiska myndigheten Centre Europrod med ansvar för arbetsmiljö
Produkten är framställd i enlighet med gällande europeisk lagstiftning gällande hälsa, miljö och säkerhet Conformité Européenne
Produkten är skyddad av patent enligt Certificat de brevet Européenne

Denna märkning visar att:
Produkten är producerad inom EU
Produkten uppfyller Europeisk miljömärkning
Produkten har genomgått en elräddhetsprüvning

Denna märkning visar att:
Produkten är ekologiskt framställd inom EU
Produkten är ekologiskt framställd oavsett ursprungsland
Produkten är odlad och inte fabrikstillverkad

Denna märkning visar att:
Produkten är inte tillverkad av barn
Produkten är inte säker för barn mellan 0 och 3 år
Produkten ska inte användas längre än tre månader av barn

Denna märkning visar att:
Produkten är mycket giftig för vattenmiljön
Produkten ska inte användas under vatten
Produkten kan ge upphov till skador på fiskar
Denna märkning visar att:
Produkten är förbjuden och får inte användas efter en övergångsperiod
Produkten är farlig och kan orsaka skador genom inandning eller kontakt med huden
Produkten är godkänd för hushållsanvändning men är dock farlig i stora mängder

Denna märkning visar att:
Produkten är mycket giftig och kan orsaka livshotande skador på djur
Produkten är mycket giftig och kan orsaka livshotande skador på människor
Produkten är förbjuden

21. Hur viktigt är det för dig att köpa produkter med en märkning som visar att produkten
framställts på ett hållbart och säkert sätt?
1 till 7: Inte viktigt alls – mycket viktigt

Tillit

22. Hur stor tillit känner du att följande aktörer gör ett bra arbete när det gäller att skydda
konsumenter från potentiellt farliga kemikalier som kan finnas i olika produkter för
hemmabruk?

- Statliga myndigheter
- Producenter av varor
- Svenska importörer av utländska varor
- Återförsäljare
- Europeiska myndigheter
- Oberoende miljöorganisationer
- Konsumentorganisationer
- Miljöorganisationer
- Forskare vid universitet

1= Ingen tillit till 7 = Stor tillit

23. Har du ytterligare kommentarer om risker med kemikalier i varor kan du lämna dem
här:

Tack för din medverkan!
ChEmiTecs Mid-term report - Appendix 3.2:
Producer survey items

Chemitecs – Producentenkät (till sifo för telefonintervjuer)
Sifo kommer att markera inom vilken bransch företaget är i utifrån en lista från SCB baserat på SNI-koder. Totalt är det åtta grupper som ingår i urvalet men för att nå rätt målgrupp ställs en utslagsfråga i inledningen.

Utslagsfråga: välj ur de som producerar någon av följande:

Skor
Bildäck
Möbelklädsel
Komponent till LCD-skärm
PVC-golv

Information
1. Om ni köper in material eller komponenter till er tillverkning eller produktion, får ni då information om vilka kemikalier som ingår i dessa?
   Ja/Nej
   Om ja, anser ni att den informationen är heltäckande?

2. Är det information som ni får automatiskt eller begär ni att få den?
   Vi får den automatiskt
   Vi begär denna information

3. Hur använder ni den informationen:
   I vårt interna arbetsmiljöarbete
   För att informera konsumenter om våra produkters innehåll av kemikalier
   Vi använder den inte alls

4. Anser ni att informationen är tillförlitlig?
   Ja/Nej

5. Hur får ni information om gällande kemikalielagstiftning?
Genom att en person har till uppgift att vara uppdaterad
Genom vår branschorganisation
Genom den information vi får från myndigheter

6. Ställer ni hälso- och miljökrav, utöver lagstiftningen, på vilka kemikalier som får ingå i er produktion?
   Ja/Nej

7. Har ni valt bort några kemikalier i er produktion?
   Ja/Nej
   Om ja, vad ligger bakom detta beslut (flera alternativ möjliga):
   Hälso- och miljöskäl
   För att ämnet är med på SIN-listan
   För att ämnet är med på REACH Kandidatlista
   Det blir billigare
   Det blir en säkrare arbetsmiljö

Riskbedömning

8. Finns det någon på ert företag som är ansvarig för kemikaliefrågor?
   Ja/Nej

9. Gör ni egna hälso- eller miljöriskbedömningar för era produkter och/eller de kemikalier som de innehåller eller anlitar ni extern kompetens?
   Utför egna
   Anlitar extern kompetens

Kommunikation

10. Ställer era kunder frågor om/hasynpunkter på kemikalieinnehållet i era varor?
    Ja/Nej
    Om ja, har sådana frågor eller synpunkter någon gång lett till att ni valt att förändra innehållet i era produkter?
    Ja/nej

11. Vilka av följande använder ni för att informera era kunder om vad era produkter innehåller (flera alternativ möjliga)?
    - Genom märkning (CE, Svanen, EU-blomman, etc)
    - Genom innehållsförteckning eller broschyr
    - Genom att tillhandahålla kontaktuppgifter (e-post och telefonnummer till kundtjänst)
    - Genom information på vår hemsida
    - Det är inte våran uppgift att informera kunderna om vilka kemikalier som våra produkter innehåller
    - Våra produkter innehåller inte farliga kemikalier
12. Ser ni några hinder för att föra fram denna typ av information? Vilka:

Saknar bra informationskanal
Informationen försvinner i bruset
Informationen misstolkas/missförstås och kan skada oss
Har ingen bra information att ge
Krävs inte av lagstiftningen

13. Hur pass viktiga är följande faktorer för arbetet med att minska miljöpåverkan av de produkter ni arbetar med (kan ange fler än ett):
   - Lagstiftning på nationell nivå
   - Lagstiftning på Europeisk nivå
   - Miljömålen
   - Konsumenttryck
   - Konkurrens / varumärkesbyggande
   - Allmänheten
   - Media
   - Kommande lagstiftning

**Miljömål**

14. Arbetar ni med det svenska miljömålet "Giftfri miljö"?

   Ja/Nej

15. Om ja, hur då? (kan ange fler än ett alternativ)
   - Genom vårt miljöledningssystem
   - Målet om en "Giftfri miljö" inspirerar vårt interna miljöarbete
   - De används i samband med tillståndsansökningar
   - De används i samband med miljökonsekvensbeskrivningar
   - Målet om en "Giftfri miljö" är vägledande när våra produkter designas
   - Målet om en "Giftfri miljö" är vägledande i våra produktionsprocesser
   - Målet om en "Giftfri miljö" är vägledande i de krav vi ställer på våra underleverantörer

16. Om nej, varför inte (kan ange fler än ett):
   - Målet är känt men inte integrerat i verksamheten
   - Det är inte relevant för mitt företag eftersom det är internationellt företag
   - Det är inte relevant för mitt företag eftersom vi omfattas i så liten utsträckning av miljömålet
   - Det är endast vägledande, inte lagstadgat
   - Det är för diffust och svårt att arbeta med
   - Det är orealistiskt och går inte att uppnå
   - Det är underordnat REACH

17. Hur viktigt är miljömålet "Giftfri miljö" som drivkraft för ert miljöarbete som rör kemikalieinnehållet i era produkter (endast ett alternativ)?
   - Viktig drivkraft
   - Viktig, men det är svårt att integrera i verksamheten
   - Viss betydelse, men det finns viktigare drivkrafter
   - Det är oviktigt
18. Deltar ni i seminarier eller annan form av utbildning som anordnas av svenska myndigheter för att lära er mer om miljömålsarbetet där det är relevant för er verksamhet (endast ett alternativ)?
   - Ja, vi söker aktivt dessa tillfällen
   - Ja, när vi stöter på dem
   - Nej, det tillför inte vår verksamhet något
   - Nej, det är inte relevant för vår verksamhet

Kompletterande frågor (finns också i Konsumentenkäten):

Rangordna följande produkter med avseende på hur pass orolig du är för att de kan innehålla kemikalier som kan vara farliga för din hälsa och/eller skadliga för miljön.
Rangordna där 1 är den produkt du är mest oroad över, och 6 den du är minst oroad över.
   - Skor
   - Bildäck och de partiklar och kemikalier som frigörs från däcken när man använder bilen
   - Möbelklädsel och de ämnen som finns som ytbehandling på textilier
   - Elektronik, som en LCD-skärm
   - Golv, plast och laminat
   - Plaster som används i nappflaskor eller matlådor

Hur stor anser du att risken är för att ämnen som är skadliga för din hälsa kan frigöras från följande konsumentprodukter? Skala: 1 (ingen risk) till 7 (stor risk)
   - Skor
   - Bildäck
   - Ytbehandlade textilier
   - Elektronik
   - Golv, plast och laminatgolv
   - Plaster som i nappflaskor och matlådor
   - Glasprodukter

Hur stor anser du att risken är för att ämnen som är skadliga för din miljö kan frigöras från följande konsumentprodukter?
   - Skor
   - Bildäck
   - Ytbehandlade textilier
   - Elektronik
   - Golv, plast och laminat
   - Plaster som i nappflaskor och matlådor
   - Glasprodukter
ChEmiTecs Mid-term report - Appendix 4:

Tentative outline for the ChEmiTecs Synthesis Book

Tentative title:

*Chemicals in articles – what is the problem and what can be done about it?*

1 Executive summary

2 “Introduction and background”

2.1 Introducing ChEmiTecs

2.2 Chemicals in articles, the problem, framing, and putting it into perspective (the concept model)

2.3 Introduction to materials chemistry (different types of emissions and how they can be measured and modelled)

2.4 Modelling approaches to evaluate risks associated with chemicals emitted from articles (chemical fate modelling incl. calibration/validation, and LCIA techniques)

2.5 Chemical stability and bioaccumulation, identification and role in risk assessment

2.6 Availability of (eco)toxicity data to assess risk; Will REACH suffice?

3 The ChEmiTecs case study approach

3.1 Selection of case study (describing the process its challenges and limitations)

3.2 Quantification of emissions of organic chemicals from the case study articles

3.3 Other sources of emissions and monitoring data

3.4 Overall conclusions from the case studies (strengths and weaknesses of the approach, representativity of cases, up-scaling to all articles and globally, comparison to total load, etc)

3.5 What has been achieved and what remains to be done

4 Generic emission modelling

4.1 Introduction to emission modelling

4.2 The ChEmiTecs generic emission model

4.3 Quantification of emissions of organic chemicals from articles in use

4.4 How can the modelling be improved?
5 Emissions from articles in perspective to other sources – risk evaluation

5.1 Identification of alternative emission sources and their relative emission strengths – Substance Flow Analysis (examples for case study chemicals)

5.2 Chemical fate assessment (where do the chemicals end up, connect back to chapter 2.5 and chapter 4.3; options for model validation/calibration)

5.3 Life Cycle Impact Assessment (screening-type non-site specific comparative assessment of risk)

5.4 Modelling and monitoring strategies for tracking chemicals released from articles

6 Problem reduction

6.1 Risk perception among consumers and producers of articles

6.2 Risk reduction through voluntary initiatives (including the role of the Swedish environmental quality objectives)

6.3 Risk reduction through legislation

6.4 The substitution principle

6.5 How can we monitor progress and measure success? (Indicators)

7 International outlook

7.1 What has been achieved and what remains to be done in the regulatory arena (including international initiatives e.g. SAICM)

7.2 Chemicals pollution in a global context (i.e. production of articles in non-EU countries, China India)

7.3 Waste management, re-use and recycling