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Voluntary Initiatives for Reducing the Use of Priority Pollutant Containing Products

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Source Control Options for Reducing Emissions of Priority Pollutants (ScorePP)

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Abstract

Voluntary initiatives by cities, industrial organisations, companies producing consumer products, Non Governmental Organisations and consumers is an interesting way of reducing emissions, especially related to diffuse sources like the use of products.

The establishment of environmental quality goals by national governments has been shown to impact on the actions of several stakeholders, providing an alternative approach to the use of legislation and regulation.

For industry, the use of voluntary initiatives could be motivated by the potential to generate a positive public image and enhance consumer confidence. These kinds of initiatives undertaken by the industry are generally intending to directly reduce emissions at production sites or to develop good environmental practices for the direct use of the products.

After having reviewed several existing voluntary agreements, this document considers the advantages and drawbacks of such initiatives and also discusses the conditions of their feasibility and success. Except if an independent controlling system is implemented the efficiency of a specific action is often difficult to quantitatively or qualitatively evaluate, especially when several factors or initiatives interact with results being reached over an extended time period. In particular, the economic value of a specific action is seldom reported. Large uncertainties are therefore connected to the evaluation of efficiency.

Acknowledgement

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Table of Contents

List of Tables

List of Figures

1 Introduction

In the Source Control Options for Reducing Emissions of Priority Pollutants (ScorePP) project one main mission is to gather information on ways to limit the release of the priority pollutants (PPs), a list of substances defined in the project (Lützhøft et al., 2008). The first task to achieve this mission was to describe substitution options, the second task to describe different measures to minimise release, technical feasibility and the Best Available Techniques (BAT), and the third task to identify legislative and regulative measures to reduce the release of PPs.

This fourth task is to identify voluntary use reduction, measures to reduce the use of PP containing products. In this report industrial initiatives and governmental/municipal initiatives are described first, as these are the main actors related to voluntary initiatives for reducing the use of products containing PPs. After this different kinds of initiatives are described separately, by examples from Sweden and the United Kingdom.

2 Review of Industry Voluntary Agreements or Initiatives

Voluntary initiatives undertaken by the industry are generally intending to directly reduce emissions at production sites or to develop good environmental practices for the direct use of the products. This type of initiatives should not only be encouraged but also officially recognized by the authorities under certain conditions.

2.1 Global Chemical Industry Agreement: the Responsible Care ®

Responsible Care® is the chemical industry's global voluntary initiative focused on improving performance, communication and accountability. Responsible Care® commits companies, through their national associations, to work together to continuously improve their health, safety and environmental performance and to communicate with stakeholders about their products and processes. This initiative, launched in 1985 in Canada by the International Council of Chemical Associations (ICCA) (ICCA 2008), representing chemical manufacturers and producers all over the world, is now run in 52 countries by the national chemical industry associations.

Responsible Care® is based on the following core principles:

- Continuously improve the environmental, health and safety knowledge and performance of technologies, processes and products over their life cycles so as to avoid harm to people and the environment.
- Use resources efficiently and minimise waste.
- Report openly on performance, achievements and shortcomings.
- Listen, engage and work with people to understand and address their concerns and expectations.
- Cooperate with governments and organisations in the development and implementation of effective regulations and standards, and to meet or go beyond them.
- Provide help and advice to foster the responsible management of chemicals by all those who manage and use them along the product chain.

Each national programme is based on these principles but degrees of freedom allow each programme to be tailored to meet local needs. Some national associations make commitment to Responsible Care® a condition of membership. The Responsible Care® commitment is signed by a chemical company's Chief Executive Officer and carried out by all employees, to continuous improvement in health, safety and environmental performance, and to openness and transparency with stakeholders. It helps companies to improve performance by identifying and spreading good management practices, and promotes mutual support between companies and associations through experience sharing and peer pressure.

Recently, the ICCA designed a Global Charter to extend and build upon the original elements of Responsible Care® as well as focusing on new and important challenges facing the chemical industry and society. The key objective of Responsible Care® is to make a strong contribution to sustainable development:

- through improved performance, expanded economic opportunities, and the development of innovative technologies
- through dialogue with stakeholders to identify additional opportunities
- by continuously improving and reporting performance
- by collecting and reporting data for a core set of environmental, health and safety performance measures.
- by developing, sharing and adopting best practices to improve environmental, health and safety performance
- by evaluating and managing chemical-related risks and benefits
- by improving product stewardship performance including transport, storage, use and eventual disposal i.e. the whole product's life cycle
- by working in partnership with upstream suppliers and downstream chemical users to collaborate on improved processes for the safe and effective uses of chemicals
- by sustaining support for education, research and testing approaches that will yield useful information about the risks and benefits of chemicals
- by increasing dialogue and transparency with other stakeholders to address their concerns and expectations
- by providing sufficient resources for implementation

On the basis of the Responsible Care® the chemical industry has developed several initiatives. For example, in 1998, the ICCA established a goal to deliver to the OECD completed information data sets (named SIDS) for 1000 global High Production Volume (HPV) chemicals. These documents collect information needed for health and environmental risk assessment of chemicals (http://www.oecd.org/document/63/0,3343,en_2649_34379_1897983_1_1_1_1,00.html). Presently, there are about 600 ICCA-submitted substances accepted in the HPV program.

The chemical industry takes pride in what Responsible Care® has helped to achieve, but knows that much remains to be done to address continuing changes in public expectations and growing concern about chemical products. Additional details on Responsible Care® can be found at www.responsiblecare.org or at www.cefic.org .

2.2 Use of Pesticides in Farming

The European Crop Protection Association (ECPA) initiated several voluntary initiatives to promote best management practices in the use of plant protection products (PPPs). These initiatives intend to

reduce emissions to water, to better protect the farmers and to increase awareness and risk perception. These are described in various brochures available on the ECPA website (www.ecpa.be).

The program "Crop protection products in water through farming practices and farmyard sources - Methods of reduction" proposes solutions to reduce or prevent PPPs from entering ground and surface waters. These solutions involve, in a cooperative approach, a number of players and stakeholders who have a common interest in reducing PPPs in ground and surface waters: farmers, regulatory authorities, crop protection industry, water companies and training agencies.

Based on practical projects and results obtained in the field, various types of solutions have been developed:

- Physical solutions, such as farm infrastructures and drainage systems;
- Technical solutions, such as changes in machinery, improved cleaning technology for spray equipment, and no-spill direct injection tank filling;
- Educational solutions, such as certification schemes, farmer training and awareness rising.

Since 1990, there are a number of examples in Europe of how collaborative and voluntary activities between players and stakeholders have reduced crop protection products in water by changes in farmyard practices, education and training, improved spraying, tank filling and rinsing practices (see Section 5.1 for details of similar initiative being run in the UK).

Through these projects diffuse and point sources have been clearly identified and reduction measures developed and communicated to the users. The details of these measures are described in European Crop Protection Association (2001).

Another ECPA voluntary programme is "The Safe Use Initiative", a European project for farmers' wellbeing. A key point of this project is to promote the preventive measures users must adopt for the correct handling of products in order to ensure the safety of the users (farmers and their workers).

Safety measures are particularly challenging in the warm, dry and sometimes humid conditions of the Mediterranean countries. In a hot climate, Personal Protective Equipment (PPE) can be uncomfortable and operators applying crop protection products might not comply with label recommendations. It is also in this area where most fresh food is produced in Europe, where pests and diseases are abundant and where, in order to protect the harvest, many treatments with crop protection products are required during the year. These were decisive factors for the industry to launch an initiative destined to improve the safety conditions of millions of farmers who work in this vast area covering Portugal, Spain, France, Italy and Greece.

This initiative started in Almería, an area in South-Eastern Spain where the most intensive greenhouse conglomeration in Europe is found, with greenhouses also creating some of the most difficult work conditions.

An expert facilitator was recruited to manage the project aided by a dedicated Steering Committee of industrial experts. The starting baseline was defined in term of workers exposure and training. On this basis, novel application equipment and technology have been proposed and implemented taking into account the specific local conditions, the biological efficacy, the residue on vegetables and the protection of workers.

This program succeeded in improving the working practices as measured using 30 different success factors and the result of this campaign was a strong reduction of the number of reported toxication incidents. There is still progress to be made in particular to improve the behaviour of workers through the more systematic provision of information.

Due to the success of this first project, the initiative is now extended to other Mediterranean countries: Greece, Portugal, France and Italy. The details of this initiative are described in the brochure reference European Crop Protection Association (2005).

2.3 Use and Production of Chemicals

On top of the general Responsible Care® initiative which is supported by the whole chemical industry, there are several initiatives covering specific groups of producers. Some of them are briefly presented here after because they are good examples of what can be achieved on a voluntary basis at European scale. Many single companies are also trying to reduce at a local level, their emissions on a voluntary basis and are very often inviting the local population to visit their installations in order to better inform the people.

2.3.1 Euro Chlor Voluntary Program

The Euro Chlor is the European Federation of Chlor-alkali producers. It represents 39 chlorine producer member companies, employing about 39,000 people at 69 manufacturing locations in 20 countries. Euro Chlor is a key link between industry, policy makers, and the general public and is representing 97% of the producers in the EU-27 and EFTA regions.

Through this Federation, the European chlorine industry has, for many years, worked to reduce its emissions on a voluntary basis.

All of the Western European chlorine manufacturing members of Euro Chlor agreed in 2001 on an industry-wide strategy that focused on six voluntary commitments (Euro Chlor 2007, page2). These were first developed to ensure a united industry approach and commitment to address key sustainability concerns:

- Include environmental, social and economic factors in all strategic business decisions;
- Optimise energy efficiency in chlorine production;
- Reduce water usage through recycling;
- Continuously reduce polluting emissions to water, air and land;
- Use more hydrogen generated by the industry as a raw material or fuel;
- Give high priority to safe transportation of chlorine.

In parallel, 14 performance indicators and improvement goals were agreed among producers and announced by Euro Chlor in January 2003. The following year, a 15th indicator was added that required members to gain EMAS and/or ISO 14001 Environmental Accreditation for their plants. These indicators cover the following main areas: economic aspects of production, environmental protection, safety and social progress.

Each year, producers are required to report their progress to Euro Chlor, which publishes the industry's annual performance and progress towards clearly defined targets (see in Euro Chlor, 2007). This programme appears to be a powerful force for change.

Some examples of targets and achievements to-date are given hereafter:

Energy Use Target

By 2010, reduce industry-wide energy consumption by 5.0% in terms of kWh/tonne of chlorine produced compared with the 2001 base year. This target was reached in 2006, four years ahead of schedule, even if the basic consumption – corresponding to the electrochemical reaction – cannot be

significantly reduced. Euro Chlor's Management Committee will now consider whether or not to reassess the goal in the light of progress.

COC Emissions Target

By 2010, emissions of 22 chlorinated organic compounds (COC) were to be reduced by 75% to water and by 50% to air compared to the 2001 base year. At the end of 2006, COC emissions from manufacturing plants had been reduced by 69.8% to water and 50.8% to air. Euro Chlor will now consider whether or not to reassess the goal in the light of progress.

The prioritised COCs were selected from various international regulatory priority lists for emissions reductions and comprise the following substances: 1,1,1-trichloroethane; 1,1,2-trichloro - ethane; 1,2-dichlorobenzene; 1,2-dichloroethane; 1,4-dichlorobenzene; 2-chlorophenol; 3-chlorophenol; 4-chlorophenol; carbon tetrachloride; chlorine; chlorobenzene; chloroform; dichloromethane; dioxins & furans (as Toxic Equivalent (TEQ)); hexachlorobenzene; hexachloro - butadiene; hexachlorocyclohexane; pentachlorophenol; tetrachloroethylene; trichlorobenzene; trichloroethylene and vinyl chloride. In 2005, pentachlorobenzene was added to the list of the substances to be monitored, in line with the requirements of the EU Water Framework Directive. The efficiency of these actions to reduce the COC emissions is demonstrated in the figures below, to water (Figure 1) and to air (Figure 2).

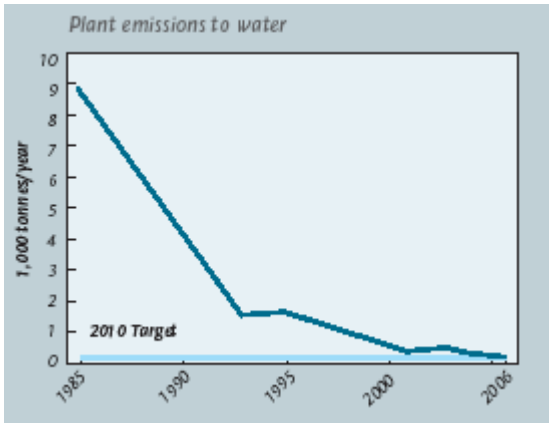

Figure 1 COC emissions to water from manufacturing plants within the Western European chlorine manufacturing members of Euro Chlor over the period 1985-2006. (Euro Chlor, 2007)

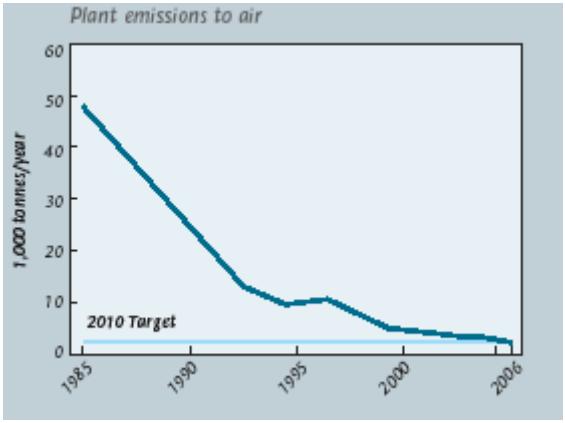

Figure 2 COC emissions to air from manufacturing plants within the Western European chlorine manufacturing members of Euro Chlor over the period 1985-2006. (Euro Chlor, 2007)

Mercury Emissions Target

Although all other programme deadlines are for 2010, the industry decided to maintain an earlier 1998 commitment to achieve an emission target of 1g Hg/t/chlorine capacity on a national basis by the end of 2007. The industry elected to keep the earlier date, since from October 2007 all EU chlor-alkali plants whether mercury, membrane or diaphragms require an operating permit under the Integrated Pollution Prevention and Control (IPPC) Directive (Euro Chlor, 2007, page 8). Overall European emissions in 2006 amounted to 1.055g Hg/tonne chlorine capacity while the average mercury emissions for Western European countries remained at the level of 1 g Hg/tonne capacity. This progressive reduction of mercury emissions is illustrated on Figure 3.

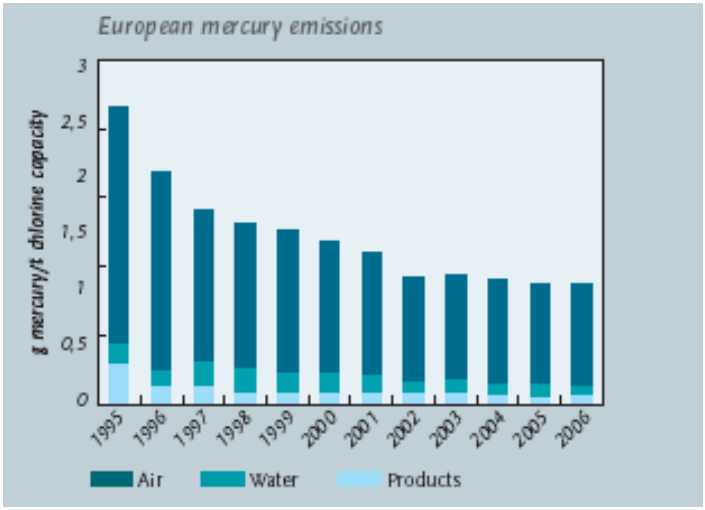

Figure 3 Mercury emissions from European chlor alkali plants to air, water and through products (1995-2006). (Euro Chlor, 2007)

During 2006, mercury plants were decommissioned and replaced by membrane technology in several countries (The Netherlands, France, Belgium, UK) representing a production capacity of 678 000 t/y of chlorine. As mercury cells are decommissioned, producers return recovered surplus mercury to Minas de Almadén in Spain, which until it ceased production was the largest mercury mine in Europe. Under a 2001 agreement with Euro Chlor, this returned mercury replaced metal that otherwise would have been mined. This route was taken because it reduced emissions from mining and processing of new mercury, saved energy and met legitimate demands for the metal elsewhere in the world. Euro Chlor is now discussing with the European authorities the safe storage of mercury in line with the mercury policy of the EU, to store this mercury in salt mines as the use of mercury should be phased out.

Product Knowledge Target

The chlor-alkali sector decided to maintain an earlier (1999) commitment to provide by 2004 full eco-toxicological and environmental data on 29 chlorinated substances under the International Council of Chemical Associations/OECD initiative on HPV chemicals. The original ICCA/OECD global chemical industry deadline of initial assessment reports for approximately 1,000 HPV chemicals by 2004 proved far more challenging to achieve than anticipated and was extended to 2009 (Euro Chlor 2007, page 8). In 2006, Euro Chlor completed four assessments bringing the total submitted to 25.

2.3.2 The Vinyl 2010 Initiative: the Voluntary Commitment of the PVC Industry

The PVC industry (PVC manufacturers, PVC additive producers and PVC converters as represented by their European associations) have united voluntarily to meet the challenge of sustainable

development. The industry adopted an integrated approach to implement the concept of responsible cradle to grave management, culminating in the signature in March 2000 of a 'Voluntary Commitment of the PVC Industry' (see Vinyl, 2006, for details). This Voluntary Commitment received a wide range of comments during an extensive phase of public and political consultation. Vinyl 2010 is the legal entity putting into practice the promises of the Voluntary Commitment.

With Vinyl 2010, the PVC industry commits to implement important principles and actions covering the period 2000 – 2010 and beyond, which apply to PVC manufacturing, additives (plasticisers and stabilisers), waste management, social progress and dialogue, management and financial scheme. This Voluntary Commitment addresses all stages of the PVC life cycle, from manufacture to end-of-life. All sectors working with PVC are involved, from PVC manufacturers to additive producers and converters. The PVC industry is involving stakeholders in the process of monitoring the implementation and the review of this Commitment.

PVC Manufacturing

PVC manufacturers commit to ensuring that each of their Vinyl Chloride Monomer (VCM), Suspension PVC and Emulsion PVC plants in Europe fully complies with The European Council of Vinyl Manufacturers (ECVM industry) charter (see ECVM, 1998a and ECVM, 1998b). The environmental criteria in this charter are in line with the "Best Available Technique" (BAT) as adopted by the OSPAR (Oslo and Paris Commissions) Commission (OSPAR, 2009). These charters contributed significantly to the final version of the Polymers Reference Document on Best Available Techniques in the Production of Polymers (BREF) that was published in October 2006 under the IPPC Directive 96/61/EC.

The PVC manufacturers are also committed to improve the eco-efficiency of PVC resin manufacturing; this means the reduction of their resource consumption, where economically and ecologically this is acceptable. This is in line with the sustainable development philosophy. An eco-profile report of PVC resin was published in 2001 and updated in 2006 in the frame of Vinyl 2010. The next step is to develop an Environmental Declaration (ED) for suspension PVC (S-PVC) and emulsion PVC (E-PVC).

ECVM represents the 14 European PVC resin producing companies who produce 100% of the PVC resin manufactured in Europe. These 14 member companies have committed to stop using Bisphenol A for the production of PVC resin. No Bisphenol A has been used in the PVC polymerisation reaction or as a stabiliser for the storage of vinyl chloride by any ECVM Member Company after 31 December 2001. ECVM has contacts with non members in order to ensure that all PVC plants in the EU respect the same rules.

PVC Additives

Stabilisers are added to PVC to allow it to be processed and to make it more resistant to external forces including heat and sunlight (ultraviolet rays). Essentially, additives include stabiliser systems used to ensure durability of the PVC plastics and plasticisers used to give a range of flexibility of the PVC. The use of these materials is subjected to a range of existing regulations. The field of regulation is continuously evolving with risk assessments playing an important role. The PVC industry fully supports and is deeply involved in the process of assessing the risks of additives.

The PVC and the plasticizers industry conducted research that largely contributed to the development of scientific dossiers to support the EU risk assessments (Phthalates Information Centre Europe, 2009) on the most commonly used phthalate plasticizers which were officially submitted in April 2006. The review of diisononyl phthalate (DINP) and diisodecyl phthalate (DIDP) showed that they do not pose any risk to human health or the environment in any of their current applications. The risk assessment for dibutyl phthalate (DBP) showed some risk to plants in the vicinity of processing sites and to workers through inhalation (DBP Information Centre 2009). To eliminate these potential risks

measures are to be taken within the framework of the IPPC Directive (96/61/EC) and the Occupational Exposure Directive (98/24/EC).

The use of cadmium in stabiliser systems placed on the EU 15 market was phased out in March 2001. This commitment is extended to the new 10 EU countries as from the end of 2006.

PVC industry performs research to develop alternatives to the widely used and highly effective lead-based stabilisers, and reaffirms its commitment to replace lead stabilisers by 2015. The first interim target of a 15% reduction was achieved in 2004 - one year ahead of the original schedule. The second interim target is 50% reduction in 2010. This commitment to phase out lead stabilisers by 2015 is extended to the EU 25.

Waste Management and PVC Recycling

Vinyl 2010 includes a number of major projects to collect post-consumer PVC waste and to identify cost-efficient recycling options for the major final applications of PVC. In the year 2000 an overall commitment of 200 000 tonnes PVC recycling/year by 2010 was agreed. This commitment has been extended to the EU 25 (from the EU 15, as was the case when the commitment was taken); keeping in mind that experience has demonstrated that the available volumes of PVC waste are actually lower than that expected in 2001. This could be due to the difficulty of collection PVC wastes as it is often mixed with other waste, making difficult the use in recycling. Recycled tonnages however strongly increased from 18,077 tonnes in 2004, to 82,812 tonnes in 2006.

Mechanical recycling is efficiently used for direct recycling of PVC waste from processing and installation works. A recent study shows that the proportion of production waste that is being recycled was close to 92% in 2004. For efficient mechanical recycling of end-of-life PVC products, it should be easy to identify and sort the products and to separate them into clean fractions suitable for further treatment. Sufficient quantities should be collected to fill industrial plant capacities, with waste transports within reasonable distances. Furthermore the quality of recyclate should match marketable applications at competitive economic conditions. Vinyloop® is a mechanical recycling technology based on separation by the use of solvents and decanter centrifuge.

It has been shown that no unacceptable risk has been identified in the use of **recycled plastics containing cadmium and lead** stabilisers which would preclude the continued recycling of PVC applications containing such stabilisers (Vinyl 2006, page 6). Accepting recycling of applications containing cadmium and lead is the most sustainable way to avoid dissemination of these substances into the environment.

Feedstock recycling is a technique in principle well suited for PVC-contaminated or mixed plastic waste, such as PVC coated fabrics, automotive interior trim, cable harnesses, flooring and other composite structures. Vinyl 2010 has invested heavily in research, development and pilot and commercial scale plants for recycling PVC containing products. However, certain processes using this technology have proven to be more challenging than expected, both technically and in terms of current economic feasibility. The PVC industry intends to continue investigating feedstock recycling processes and to support those that appear promising.

Municipal solid waste incineration and other recovery processes

Municipal solid waste incineration (MSWI) with energy recovery will play an increasingly important role in sustainable waste management concepts. PVC present in the waste stream contributes to energy recovery. Salt residues are by-products of some MSWI technologies. Only parts of these residues are due to PVC waste. The PVC industry commits to support technology developments in order to minimise the quantities of salt residues produced and to develop purification technologies, with the objective to recover the salt to be reused in chemical processes, and minimise the final residues to be disposed.

Vinyl 2010 has gained a wealth of experience of the self-regulatory approach and in promoting involvement throughout the value chain of PVC. The PVC industry has continued to support innovative ways to produce, collect and recycle PVC, dedicated time and resources to reduce the environmental impact of PVC, as well as supported the life-cycle approach and stakeholder dialogue. Expenditure by Vinyl 2010 amounted to €7.09 million in 2006.

Vinyl 2010 is committed to transparency and has engaged independent auditors and verifiers. The financial accounts, the statement of tonnages of products recycled, the phase-out of lead in drinking water pipes and the Progress Report 2007 were audited and verified as giving a true and honest representation of performance and achievements.

The key achievements of this voluntary programme over the 2000-2006-period are as follows:

- Cadmium stabilisers phased-out in EU-15 (2001)
- Bisphenol A phased out of PVC production in all ECVM member companies (2001)
- 25% recycling of pipes, windows and waterproofing membranes (2003)
- Recognition of Vinyl 2010 as a partner by the UN Commission for Sustainable Development (2004)
- Risk assessment on lead stabilisers published (2005) and 15% reduction in lead stabiliser use achieved ahead of time (2005)
- External verification of ECVM S-PVC and E-PVC production charters (2002 and 2005 respectively)
- Phthalate risk assessments completed (2005) and published (2006)
- Lead stabiliser phase-out in 2015 extended to EU-25 (2006)
- Cadmium stabiliser phase-out extended to EU-25 (2006)
- Recycled tonnages increasing exponentially from 18,077 tonnes in 2004 to 82,812 tonnes in 2006

For further details on the Vinyl 2010 results see Vinyl (2007).

2.3.3 The Voluntary Emission Control Action for Brominated Flame Retardants

The Voluntary Emission Control Action Programme for Brominated Flame Retardants (VECAP) is a major Responsible Care© commitment of the brominated flame retardant (BFR) manufacturers aiming to prevent or eliminate emissions to the environment in a sustainable and measurable manner, both from manufacturing facilities and from end-user sites throughout the supply chain.

Initially VECAP was set up in Europe for the flame retardant deca-BDE, following the finalisation of the deca-BDE (deca bromodipheyl ether) risk assessment in 2004 in the EU. This risk assessment did not identify any risk from the use of deca-BDE in plastic, or in any other applications (Bromine Science and Environmental Forum, 2009). However the European authorities expressed their concern at findings of deca-BDE at very low (but rising) levels in the environment close to industrial sites. During the final stages of the risk assessment, it was identified that the significant emissions into the environment could be traced to point sources. These point sources were typically found where aqueous applications were taking place, such as for textiles and carpets where deca-BDE was used to achieve the required flame retardancy. A secondary source of emission was from practices in handling deca-BDE powders in the plastics industry. The European Brominated Flame Retardant Industry Panel initiated the VECAP in 2004. The programme originally started in the UK textile industry, but was quickly expanded to include plastic applications and the other major deca-BDE users in the EU.

The progress achieved by the programme and the users' commitment have motivated the brominated flame retardant industry to roll out VECAP globally, and to implement it for other flame retardants, in particular tetrabromobisphenol A (TBBPA) and hexabromo-cyclododecane (HBCD).

Initial results show that VECAP is both a practical and cost-effective way of controlling emissions of BFRs. Users and producers are taking forward a series of simple and low cost measures at the plant level by which the BFR emissions can be significant reduced. VECAP also appears as a potential model for chemical management in general.

The focus of the first three years of VECAP for deca-BDE has been to introduce and implement the programme in the six EU Member States (Belgium, France, Italy, Germany, The Netherlands, and United Kingdom) which account for around 95% of the deca-BDE usage in the European Union. Since 2007, VECAP has been extended to the other EU countries.

To implement the VECAP principles a Code of Good Practice has been developed (VECAP 2008, page 5). According to this code, the producers will provide guidance to their customers on the correct handling and processing of BFR and may refuse to supply the users who do not provide such assurances that the code of practice is being followed. The users will analyse product flows and processes to define where efficiency improvement is feasible, gather data on waste flows and product loss and achieve emissions control.

Once a user has agreed to implement the VECAP principles, it must first calculate its mass balance ratio to establish a baseline of its actual process and related emissions (e.g. water and air emissions). The objective of this baseline is to collect data for an evaluation of the environmental performance and to obtain a reference point to allow the measurement of future improvements.

Up to now the main achievements of VECAP are the following:

- 97% of deca-BDE used in the EU textiles industry in the key six EU Member States has been covered by VECAP with the first mass balance measurements completed.
- 82% of deca-BDE used in the EU plastics industry in the key six EU Member States has been covered by VECAP and the first mass balance measurements completed.
- The third annual mass balance by the UK textiles sector shows a 97% estimated emissions reduction overall to water, thus demonstrating the effectiveness of the VECAP process.
- Auto and retail companies are starting to specify VECAP for upstream suppliers of textiles and plastics. VECAP Best Available Technique guidance is proving effective.
- Initial measurements at plant level indicate that, by using guidance for emptying packaging containing BFRs, the amount of deca-BDE left in the bags can be significantly reduced.

The positive response to the VECAP initiative for deca-BDE is such that it is extended to the other high production volume brominated flame retardants, HBCD and TBBPA. In 2006, VECAP was introduced in Europe for the additive plastic applications of TBBPA and, since early 2007 it is also being applied to its reactive plastic applications. To date, 89% of the additive TBBPA plastics users in Europe by volume have committed to reducing their emissions and established a baseline. One of the objectives of VECAP for TBBPA additive applications is to reduce emissions to water and sediment as per the need identified in an EU environmental risk assessment. The use of HBCD is also covered by two emission control programmes: VECAP for textiles and plastics and SECURE for HBCD uses in polystyrene foams.

VECAP is also extended to other world regions. In North America, VECAP was launched in the United States and Canada in 2006 (VECAP 2008, page 12) and has focused on visiting deca-BDE users and helping them in completing the initial baseline surveys and, educating interested parties by organising workshops to introduce VECAP to regulators, non-government organizations, trade groups and others interested in controlling and reducing emissions of BFRs.

Around 95% of deca-BDE users in the U.S. and Canada have now been introduced to the programme and around 35% are already actively implementing it. Since the introduction of the programme, 23% of the deca-BDE usage by the North American plastics industry has committed to apply VECAP and 64% of the deca-BDE usage by the North American textiles industry has committed to apply VECAP. The focus in 2007 in this world region has been to establish the first mass balance surveys.

A similar VECAP has been established in Japan. The Japan VECAP is focused in a first phase on HBCD and involves producers and users from the textiles and polystyrene foam industry. The focus on HBCD follows consultations with the Japanese government authorities. The Japanese government is also an active partner.

Industry is also currently assessing the feasibility of introducing VECAP in China.

On the basis of the successes in reducing levels of deca-BDE in the environment, the bromine industry has expanded the VECAP initiative to other BFRs and other world regions. There is a strong industry commitment to the programme in order to achieve further emissions reduction throughout the supply chain. There is also a will for transparency and to keep regulatory authorities, other stakeholders and the general public regularly informed on the progress made.

Details on the VECAP initiative are available in VECAP (2008).

2.3.4 By-products

On the list of priority pollutants in the Water Framework Directive, there are several by-products from the chemical and petroleum industry which has been the subject of voluntary emission reduction measures by the industry.

HCB and HCBD – In the frame of its voluntary programme described above, the member companies of Euro Chlor drastically reduced the emissions of hexachlorobenzene (HCB) and hexachlorobutadiene (HCBD), two by-products of the chlorine industry.

From 1985 to 1998, emissions of HCB from Euro Chlor member company sites (about 80 sites) have dropped down to 90 kg/year to water and 3 kg/year to air, representing a reduction of 87 and 97% respectively. Similarly, over the same period, emissions of HCBD to water from Euro Chlor member company sites (about 80 sites) have been reduced by a factor of 40 down to 140 kg/year (http://www.eurochlor.org/upload/documents/document66.pdf). With improved manufacturing processes, HCBD is no longer detectable in chlorinated organic products on the market.

PAHs – One possible source of PAHs is oil refineries. Under the CONCAWE umbrella, the Western European oil refineries are, since 1969, regularly carrying out surveys on refineries' effluent water quantity, oil content and treatment processes. These surveys show a continuous trend in the reduction of oil discharges. The ratio of oil discharged compared to the amount of oil processed is continuously falling. Since 1969, the quantity of oil discharged has reduced by 98% from 44,000 tonnes (from 73 refineries) to 747 tonnes (from 84 refineries) in 2000 (Figure 4). Oil discharged has been reduced to 1.42 g oil per tonne of oil processed. As there has been little change in the total volume of effluent when only the same refineries are considered, the efficiency of effluent purification has therefore continued to improve. A report presented by CONCAWE (2004, page 4, Conservation of clean air and water in Europe – the oil companies' European association for environment, health and safety in refining and distribution) indicates that 92% of the refineries surveyed now include at least one stage of biological treatment in their wastewater treatment facilities. An example of progress report is given in CONCAWE (2004).

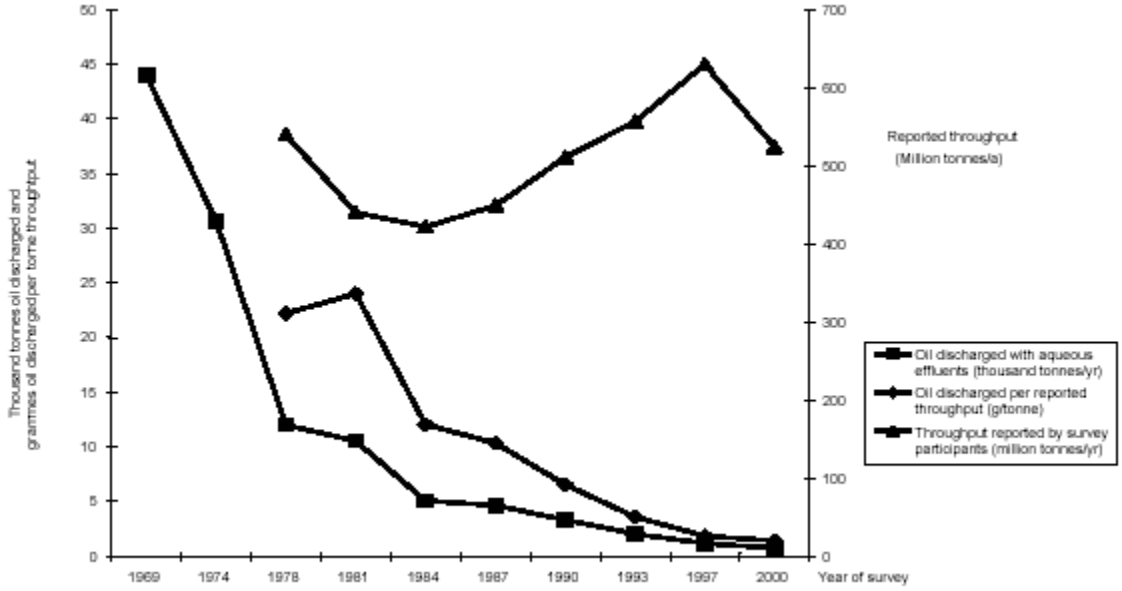

Figure 4 Trends in amount of oil discharged compared to refinery throughput in 1969-2000; oil discharged with aqueous effluents (thousand tonnes/yr), oil discharged per reported throughput (g/tonne) and throughput reported by survey participants (million tonnes/yr). (CONCAWE, 2004)

2.4 Initiative by a Company to Phase Out Substances from Products - Cell Phones

Sony Ericsson is a company producing mobile communications systems, mainly cell phones and accessories, which has worked to implement a life cycle approach to product development that takes into account materials, design, supply chain, manufacturing, product use (operation) and end of life treatment. An environmental goal is to develop and deliver solutions that help to reduce global resource consumption and emissions to air, land and water. The reason they give is that their customers demand environmentally adapted products and services and that they are committed to meeting that demand. The attempt is to lead the way in phasing out unwanted substances, by replacing potentially harmful chemicals with safer alternatives, according to the precautionary principle. Working towards reaching future environmental demands on material content, energy consumption, batteries, packaging and recycling involves asking Sony Ericsson's suppliers, vendors and manufacturing partners to deliver components that reach the company's goals (Sony Ericsson, 2008). This kind of green procurement is combined with environmental declarations (e.g. see Sony Ericsson, 2004), for each product, and to invite any interested parties to obtain factual information (see Section 4 for further information on green procurement). By open information costumers can more easily make choices when purchasing.

2.4.1 Results and Discussion of Sony Ericsson Initiatives

Substances avoided until now are those included in the EC directive on the restriction of hazardous substances (RoHS); lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE). They are excluded in amounts exceeding the established maximum concentration values, on the market. Currently Sony Ericsson is working on phasing out antimony, beryllium and phthalates from their products. As can be seen in Länsstyrelsen (2008) this does not mean their products are free from these unwanted substances, but that they do not exceed some maximum concentration values. Legislative instruments and especially the legislative pre work are important prerequisite for this phasing out work. The environmental approach is neither something they raise in their advertising, as the technical features are more important for the customers.

2.5 Advantages and Drawbacks of Industrial Voluntary Approaches

The key advantage of the industrial voluntary approach is the commitment of industry to demonstrate progress and improve their image. In comparison with a legally binding approach, the benefit of voluntary agreements in terms of positive image is much higher.

Moreover, the actions agreed on a voluntary basis are generally much more realistic than the requirements of politicians who have less knowledge of the industrial life and constrains. Politicians are generally acting on the basis of ideological principles and public opinions which are not necessarily applicable such as the concepts of complete phase out or the zero level. On the contrary, industry associations are working on a pragmatic basis which leads to technically and economically feasible measures.

The main drawback of industrial voluntary approaches is the poor confidence the public and environmental organizations have in industry willingness to really reduce emissions and protect the environment. This scepticism is favoured by the media who usually like to report on negative aspects rather than on positive actions. This negative perception of industry is also very common within the world of politics and parliamentarians.

The key difficulty of industrial voluntary agreements is precisely linked to the lack of confidence the public and the authorities have in industrial proposals. A suspicion towards industry is continuing to prevail mainly at a political level. For example, in the EU, even if it were possible to get support for industrial voluntary agreements the Commission level, it is almost impossible to gain any support at the Parliament level. This appears to be a real limiting factor in the development of such agreements.

Considering this lack of confidence, the key acceptability factor of industrial voluntary agreements is to organize an external independent audit of the progress really made towards the objective of the agreement. Such an auditing exists for example for the Vinyl 2010 initiative (Vinyl, 2006). In the case of the reduction of mercury emissions in chlor-alkali industry, a regular audit is made by OSPAR HSC (OSPAR Commission Hazardous Substances Committee). The regular publication of the results is also a key to increasing the acceptance of these agreements.

The feasibility of implementing industrial voluntary agreements is of course linked to the commitment of the member companies of the association and to the definition of both clear targets and appropriate time tables. These targets should be demanding enough to be credible vis-à-vis the outside world but realistic and accessible enough to be accepted by the companies. One of the best approaches is the progressive revision of targets as a function of the progress obtained. Industrial voluntary agreements can also be considered as a positive competitive challenge for the members of the association.

3 Municipal Voluntary Initiatives

3.1 Environmental Goals as Voluntary Initiatives

In the autumn of 2001, the Swedish Parliament committed to achieving the following national generation goal, “We shall pass on to the next generation a society in which the major environmental problems have been solved”, meaning that environmental impacts must be reduced to sustainable levels before 2020 (Swedish Environmental Objectives Council, 2008c). The generation goal is described in 16 environmental quality goals, which have been translated to a regional county level and also to the local municipality level, to connect more locally with a shorter time span and to make the national goals more achievable. One goal is “a non-toxic environment”, defined as “the environment must be free from man-made or extracted compounds and metals that represent a threat to human health or biological diversity”.

3.1.1 Stockholm's Environmental Programme 2002-2006

Stockholm's environmental programme 2002-2006 (Stockholms stad, 2003) is one example of the municipality level of implementation of the national environmental quality goals. Stockholm's environmental programme was structured into six target areas or main goals, each linked to one or more of the national environmental quality goals. (There is a new environmental programme for Stockholm for the years 2008-11 (Stockholms stad, 2008a), but since this has not been evaluated this discussion will focus on the programme for the previous period). Each main goal was broken down into detailed subsidiary goals, aimed to be achieved during the programme period. The subsidiary goals focused on the causes of environmental problems and the measures that would be needed to be taken during the programme period to enable the City to work preventatively. The ultimate responsibility for fulfilling the commitments lay with the City's committees and boards and with the companies over which the City had influence. The City's rights of disposition and ability to exert influence had consequently been of considerable importance in identifying the goals. The City is responsible for a number of issues in which the environmental dimension is a significant one, e.g. physical planning, childcare, schools, waste management, the operation and maintenance of roads, civic engineering and real estate, the care of green areas and parks, and the supervision of environmentally hazardous activities.

The six main goals in this programme were:

1. Environmentally efficient transport
2. Safe products
3. Sustainable energy consumption
4. Ecological planning and management
5. Environmentally efficient waste processing
6. A healthy indoor environment

The second goal, "Safe products", has a focus on chemical substances and is hence the most relevant in the case of ScorePP priority pollutants, why it is described in more detail. The goal was specified as:

"Our environment shall be free from toxins. The City shall demand that chemicals, and other products and services are environmentally friendly. The City shall set a good example in the environmental demands it places on building materials, vehicular equipment, electronics and foodstuffs, for example. Our knowledge of the effects of harmful substances on people and the environment must increase, as must households' knowledge of environmentally friendly products and organic foodstuffs."

3.1.2 Results and Discussion of Municipal Goals

Connected to the goal "safe products", several subsidiary goals were to be achieved during the programme period. The results of the program in relation to subsidiary goals relevant to the ScorePP project are here described to support discussions on the efficiency of the Environmental Programme as an initiative. In the evaluation after the project period (Miljöbarometern, 2007) different graphical symbols were introduced to show the outcome:  goal obtained,  goal partly obtained, and  when the goal was not obtained.

1. The presence of the substances prioritised in the EU's General Directive for water shall be measured. If the substances are present in the form of environmental contamination, draft measures shall be produced.  The 33 Water Framework Directive priority substances were analysed in sediment samples in surface water areas within the municipality of Stockholm. For substances found in concentrations of concern, i.e. had the highest concentration in relation to

the probable no effect concentration (PNEC values), sources were identified through substance flow analysis and measures were proposed.

2. The City's administrations and municipal companies shall present plans detailing how the most environmentally friendly chemicals and products are to be purchased. The municipality is an important player and can demand environmental requirements when purchasing chemicals and goods. Knowledge is needed to succeed, though. Only 37 % of the administrations and companies answered, after the program period, that they had a plan for how to purchase the most environmentally friendly chemicals and goods. No specific evaluation of the used criteria was made. On the other hand, a guide had been produced to support purchasers, which should make it easier to demand environmental requirements. (See Ravan, 2006)

3. The City's activities shall increase the percentage of organically produced foodstuffs bought to at least 15%. The purchased amount of organically produced foodstuffs increased during the program period but did not reach the 15 % goal.

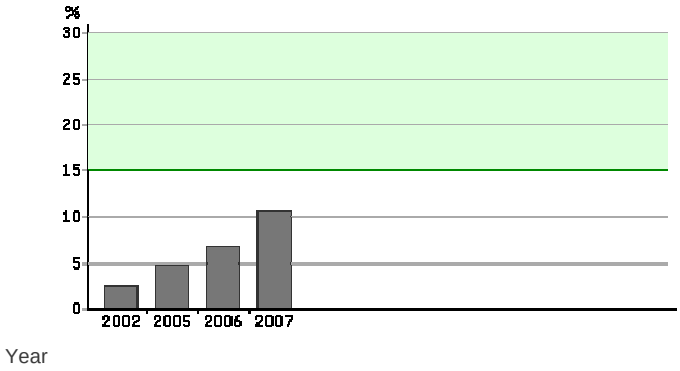

Figure 5: Proportion of organically produced foodstuff bought by the municipality of Stockholm. (Miljöbarometern, 2007)

4. The City shall work to eliminate the use of amalgam by dental health care services. The city worked in several ways to reach this subsidiary goal. Seminars for dentists were arranged where information on the environmental impact of dental care was given together with information about possible measures, as well as visits for inspection and information. The Stockholm water company offered over a time period of several years (commencing in 1999) an economic contribution to dentists decontaminating their wastewater tubes. The new use in dental care decreased to practically zero. However, most of the mercury that exists in Stockholm (3 tons of a total amount of 5 tons) exists as amalgam in inhabitants teeth. This amalgam will continue to release mercury for a long time. At dental care surgeries, however, the majority of the amalgam that is released will be trapped in special equipment installed for this purpose.

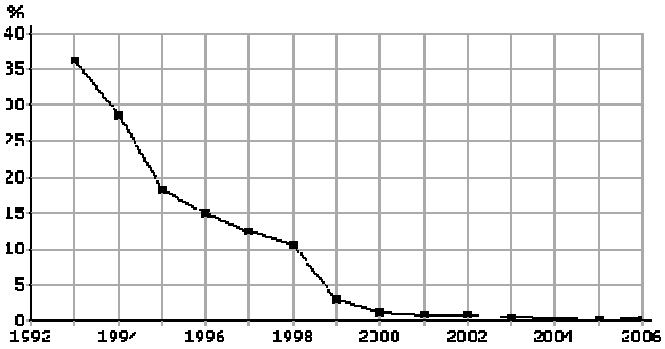

Figure 6: Proportion of amalgam in new tooth fillings. (Miljöbarometern, 2007)

5. The City shall work to discourage the use of lead sinkers in fishing. Since lead was phased out in petrol, the major sources of lead in the Stockholm environment are ammunition and sinkers for fishing in running water. In several fishing competitions during the program period lead sinkers were not allowed. Information campaigns targeted shops for angling equipment to persuade shop owners to stop selling lead sinkers and to stock a selection of alternative sinkers. This reduced the amount of lead annually emitted to the Stockholm watercourses from angling from 5 tons to less than 0.5 ton. As long as there is a free fishing in the main watercourses in Stockholm a ban could not be introduced, unlike in private lakes where the owners can control the hired fishing rights. Something on the importance; Angling is an important leisure activity and 10% of the area in Stockholm consists of water (Stockholms stad, 2008c).
6. The City shall work towards a reduction of at least 30% in the use of art paints containing cadmium. There is a general ban on cadmium since the beginning of the 80's, but art paints are exempt. Due to the legislative exemption the city could only inform about the importance of reduced use of cadmium-containing paints. (See more in section 6.7.1)

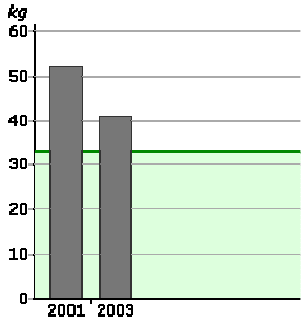

Figure 7: Amounts of cadmium in artist paints sold in Stockholm (Miljöbarometern, 2007)

Together with the 2nd goal, described above, the 5th goal "Environmentally efficient waste processing" ties in with the national environmental goal of "A Non-Toxic Environment (see section 3.1). One subsidiary goal demands that wastewater sludge be reused as a phosphorus source, phosphorous cycling should be at least 50% in 2006. To use the sludge as phosphorous source on agricultural land concentrations of some metals and organic substances must decrease. Mean concentrations of analysed metals (Cd, Hg, Ni and Pb) are lower than threshold values set for agricultural land. Decreased concentrations in sludge show that work targeting sources of PPs has been successful (Fig 8-13). Since 2003 all sludge produced at the treatment plants in Stockholm is sent to abandoned mining areas, where it is used to produce growth of grass and bushes, i.e. the subsidiary goal more than reached. As threshold values for use on agricultural land are reached, this is a possible use in the future, if farmer organisations accept it.

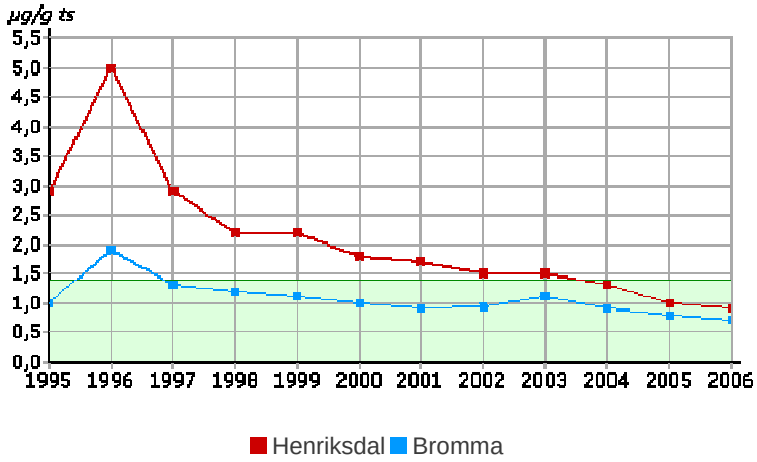

Figure 8: Mean concentration of mercury in wastewater treatment sludge from the two major wastewater treatment plants in Stockholm, Henriksdal and Bromma. (2.5 µg/g ts (dw) is the threshold value for use at agricultural land). (Miljöbarometern, 2007)

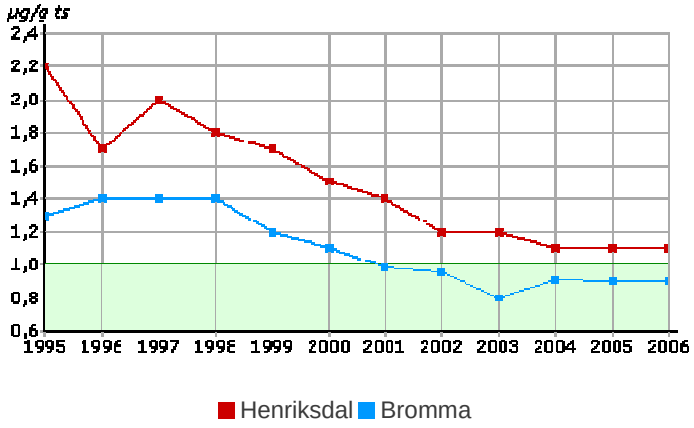

Figure 9: Mean concentration of cadmium in wastewater treatment sludge from the two major wastewater treatment plants in Stockholm, Henriksdal and Bromma. (2 µg/g ts (dw) is the threshold value for use at agricultural land) (Miljöbarometern, 2007)

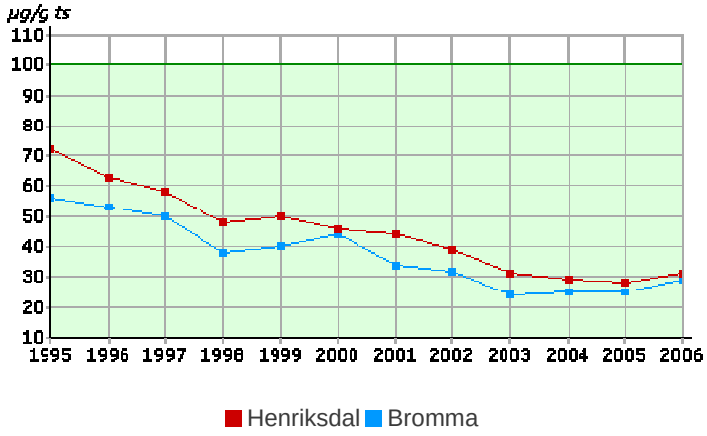

Figure 10: Mean concentration of lead in wastewater treatment sludge from the two major wastewater treatment plants in Stockholm, Henriksdal and Bromma. (100 µg/g ts (dw) is the threshold value for use at agricultural land) (Miljöbarometern, 2007)

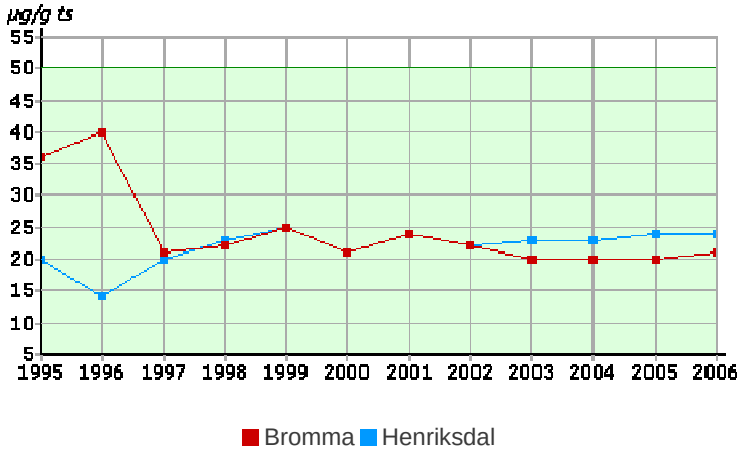

Figure 11: Mean concentration of nickel in wastewater treatment sludge from the two major wastewater treatment plants in Stockholm, Henriksdal and Bromma. (50 µg/g ts (dw) is the threshold value for use at agricultural land) (Miljöbarometern, 2007)

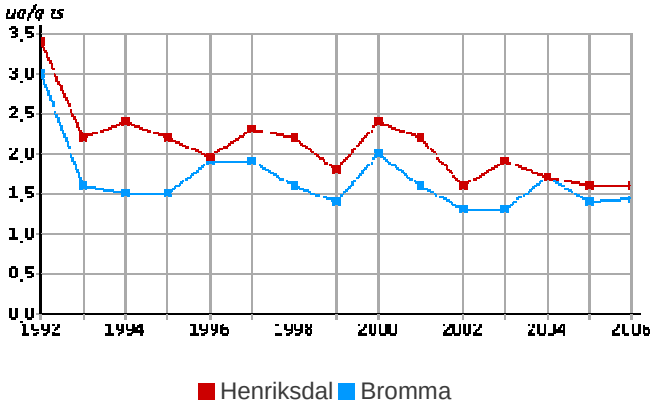

Figure 12: Mean concentration of PAHs in wastewater treatment sludge from the two major wastewater treatment plants in Stockholm, Henriksdal and Bromma. (No threshold value exist for use at agricultural land) (Miljöbarometern, 2007)

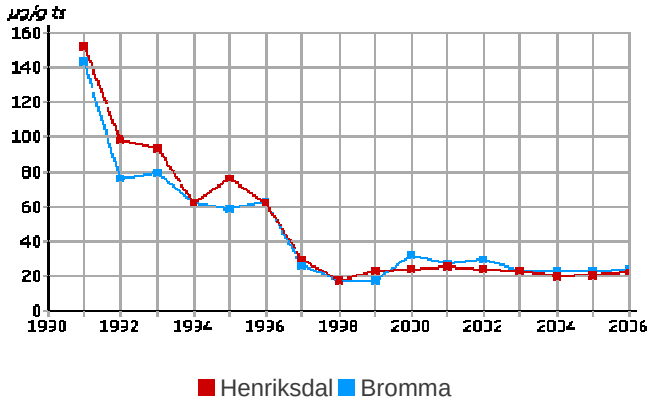

Figure 13: Mean concentration of nonylphenols in wastewater treatment sludge from the two major wastewater treatment plants in Stockholm, Henriksdal and Bromma. (No threshold value exist for use at agricultural land) (Miljöbarometern, 2007)

Another subsidiary goal under the goal "Environmentally efficient waste processing" was "Households and commercial activities shall be afforded good preconditions for screening out hazardous waste. Substances harmful to the environment and people's health shall not leach out into the environment."

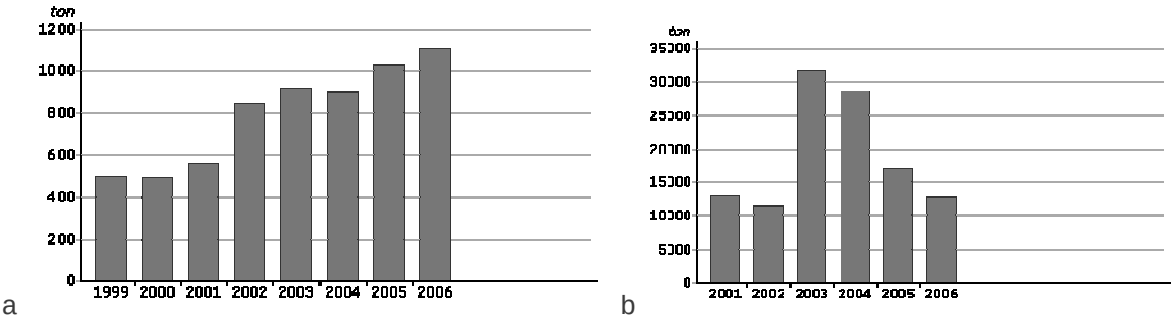

Figure 14: Total amount hazardous waste (tonnes) collected from a) households and b) commercial activities per annum. (Miljöbarometern, 2007)

The amount of hazardous waste from households that has been collected increased during the programme period but it is not shown how much of this increase that is due to increased consumption of products. As polluted soil is included in amounts from commercial activities differences between years are difficult to interpret. From these findings it can be learned that it is important to formulate good goals which can be readily assessed.

Percentage of households sorting their hazardous waste at source was another key ratio within this sub goal. It monitors the percentage of households in the City of Stockholm who sort their hazardous household waste into different fractions at source. It also indicates inhabitants' awareness and knowledge of hazardous waste and their familiarity with Stockholm's system for collecting hazardous household waste. Data was taken from the Stockholm civic survey, which is sent out to randomly-selected households in the City of Stockholm every three years (Stockholms stad, 2008b). According to this questionnaire the percentage rose from 61% 2004 to 70% 2006. The Waste Management Committee and the Environment and Health Committee performed extensive information campaigns during the programme period towards different players in the city. One way of increasing the screening out of hazardous waste could be to improve the service, especially the service provided for companies with small amounts of hazardous waste. From these key ratios it was stated that this goal had been partly reached.

3.2 The Residential Area Hammarby Sjöstad as a Voluntary Initiative

In Stockholm a new eco friendly city area was planned in the 1990s, to be completed with 11 000 flats and 25 000 inhabitants in 2017. In this district the City has imposed ambitious environmental requirements on buildings, technical installations and the traffic environment (Fränne, 2007).

The city area Hammarby Sjöstad is interesting to study because some materials have been avoided during the development of the area in order to reduce the leaching of unwanted substances into the environment. Stormwater is not connected to the sewerage system in order to improve the quality of the wastewater and sludge. This gives the opportunity to study the contribution of unwanted substances from households.

3.2.1 Green Procurement and BASTA – Phasing Out Very Dangerous Substances from the Construction Industry

One of the requirements when Hammarby Sjöstad was built was to follow the so called BASTA (a Swedish abbreviation for "Phasing out very dangerous substances from the construction industry", http://www.bastaonline.se) system when building work was procured, with an agreement to comply with BASTA being a requirement of the contract.

The BASTA, is a system through which the Swedish construction sector has agreed a common definition of a substance's properties which determine whether a product is to be accepted or not. The criteria mean that products must not contain chemical substances (above stated concentrations) with the following properties:

- carcinogenic substances
- mutagenic substances category (cause heritable genetic damage)
- substances toxic to reproduction category (impair fertility)
- persistent or very persistent substances (low degradability)
- bioaccumulative or very bioaccumulative substances (accumulate in tissue)

The content of sensitising substances, solvents and acutely toxic substances is also limited in chemical products.

These substance properties are based on the plans in the REACH regulation. The burden of proof in the BASTA system is put on the supplier, who has to confirm whether the product meets the criteria or not. A system of self-declaration of this kind needs to be supplemented by a quality assuring auditing, and the BASTA project has drawn up the procedures to ensure that such validation can be carried out in a credible and cost-effective way. For the dissemination of the suppliers' assessed products, the BASTA project has developed a web-based database. The industry standard for properties criteria has been developed with broad endorsement by large parts of the Swedish construction sector, which is crucial to the future success of the system. It has been possible for this to be done through great openness in the drafting of these criteria. The validation method that is to assure the system of credibility consists principally of two parts: firstly requirements relating to the supplier's expertise, documentation and organisation, which are collated in a contractual document which each participating supplier signs, and secondly random-sample audits of the suppliers´ data. (http://www.bastaonline.se)

3.2.2 The Project "Pure Wastewater" by the Municipal Wastewater Company

During the period 2000-2005, the project "Pure wastewater" took place in Hammarby Sjöstad (Lindh, 2006). The two parts of this project were as follows:

- The wastewater and sludge from Hammarby Sjöstad was analyzed and compared with wastewater and sludge from the large wastewater plant Henriksdal in Stockholm. The purpose was to see if the environmental approach while building Hammarby Sjöstad had had any effect on the amount of pollutants in wastewater and to measure how polluted water is from households.
- Environmental information was given to the inhabitants of Hammarby Sjöstad in order to see if that could lower their contribution of unwanted substances to the wastewater. A campaign about litter, washing detergents (LAS) and tooth paste ingredients (triclosan) took place in March 2005 and was successful in reducing litter and unwanted substances in the wastewater.

3.2.3 Results and Discussion of Hammarby Sjöstad Initiatives

Analyses of wastewater and sludge from Hammarby Sjöstad showed that the levels/concentrations of many substances were considerably lower than at Henriksdal. These results show that green procurement and separate stormwater systems have a positive effect. Following these positive results this city area was used as a positive example in the planning of other building projects in Stockholm and elsewhere.

Some of the substances focused on in the campaigns showed lower levels in water and sludge after the campaign, but it was stated that repeated information activities are needed to get a long term change, and that repeated analyses are needed to clearly demonstrate any change. Changing people's behaviour is possible by information, but it was also found that it is important to know well the target group of people when working with information to change behaviour. In this case it was found that the people had good environmental knowledge and that they were willing to change behaviour if there are good and simple solutions. They wanted simple information outlining what an individual can do, why and the consequences. They also wanted the information to be repeated and to get feed-back on results. This knowledge can be used in subsequent information campaigns. From a poll and reactions to an exhibition (part of the information work), the campaign was seen as a success. However, although the load of chemical substances included in the information campaign showed decreases the measuring period before and after the campaign was considered to be too short to show significant changes. In particular, the processes in the small wastewater treatment plant could not be seen as stable providing a second possible source of variation which could also result in variations in concentrations of organic substances in sludge.

3.3 Wastewater Treatment Plants Voluntary Initiatives - The ReVAQ-Project

Use of sludge on arable land for food production has been a question for a long time in Sweden. An argument for using the sludge as fertilizer on arable land has been that phosphorous is a limited resource necessary for food production, while arguments against its use have focused on the content of different pollutants in the sludge that make the use on arable land impossible. In Sweden today, only a small portion of sludge is used on arable land for food production, while most is used for construction soil or covering purposes. To be used on agricultural soils national regulations set values for the maximum content of lead, cadmium, copper, chromium, mercury, nickel and zinc in the sludge, the maximum allowable content of these metals in soil where the sludge will be spread and the amount of these metals that is allowed to be spread during a unit of time and area. Some recommended limiting values also exist for PAH, PCB and nonylphenols. Although the sludge quality has improved and the conditions set out in legislation fulfilled, the Farmers Association and other interests think there is still uncertainty whether the sludge can be spread (Länsstyrelsen, 2008). For this reason a project started in 2004 – the ReVAQ project, a Swedish shortening for "Clean nutrients from the sewer" (Kärrman et al., 2007). The aim of this project was to investigate if sludge from municipal wastewater treatment plants could be sustainably used for food production in the long run. Another aim was to develop a solid and trusting cooperation between the participating interests. The project gathered the most important actors in an active steering group and involved an enlarged co-operation between participating municipalities. The work was evaluated by an independent auditor, on the quality improvements of the sewage sludge as well as the change of perceptions and attitudes of e.g. the participating municipalities and the users of the water systems. The ReVAQ project work was divided in three different parts:

1. Mapping and measures upstream

- Identify sources
- Construct mass balances from sources to the farmland
- Identify connected industries, make chemical lists where each industry report use of chemicals

- Characterise the stormwater, drain water and leachate water input and eventually disconnect
- Information campaigns to connected households and activities/operators/businesses

2. End of pipe measures and control at the WWTP

- Self-control at the WWTP
- Sample incoming and outgoing water and sludge at each WWTP, and use results to make mass-balances and to register the sludge quality
- Register sludge transports to manage traceability

3. Sampling and traceability on farmlands

- Sample soil at the farmland before and after dispersal
- Analyse crop
- Hold registers on sampling and analytical results

3.3.1 Results and discussion

The ReVAQ project was found to be well designed for achieving the goals. The success was due to an active steering group of key actors, which established a trustful way of work, and co-operation between municipalities. Improvements of the quality of sewage sludge occurred regarding cadmium, silver and mercury but less prioritised metals (Cu, Zn and Ni) did not show any trend of decreasing loads during the project. From this project no trends could be found regarding concentrations of organic priority substances (Wahlberg, 2008).

It was concluded that in short term, there are no known serious problems for the environment or health connected to the use of sludge in agriculture following the ReVAQ–process. On the other hand, in long term there is an ongoing accumulation of metals in the farmlands; which can only be changed with an improved quality of sludge in combination with decreased atmospheric deposition. Another conclusion was that further preventive environmental work should be prioritised.

3.4 Advantages and Drawbacks of Municipal Voluntary Initiatives

The national and local environmental goals have been important in progressing towards a less chemically harmful environment, as these goals have been adopted across a broad scale of stakeholders (Swedish Environmental Objectives Council (2008a,b). Without the environmental goals this work would probably have been less focused and less would have been obtained. By making local and more time defined goals and key ratios which are possible to follow up, the awareness and belief of all parts of the society has increased. The environmental work has become more legible which is important to ensure that the national goals are achieved.

Through communication and the establishment of voluntary agreements between a municipality and other players (such as the chemicals industry and electronics manufacturers), a municipality could have considerable influence on the spread of hazardous substances. Other influential players include the energy and traffic sectors' operators and those operating in the field of infrastructure and construction development work. A municipality can also influence the spreading of hazardous substances by procurement processes, and can impose demands with regard to the substances that must be avoided and, when allocating land, with regard to the materials that should be selected for use in buildings and the infrastructure. The City of Stockholm can encourage an eco-friendly approach in its capacity as a major purchaser of products and services, by being environmentally proactive in its approach and thereby setting a good example (see Section 4 for further information on green procurement).

Although this work has been successful in many ways there are some weaknesses. The lack of absolute obligations is one. When several interests are competing stakeholders do not always prioritise environmental goals. As has been stated above, it is also important to formulate clear subsidiary goals and find good ways for following up the goals. In a national evaluation it was stated that major gains in efficiency can be achieved through closer coordination between the relevant authorities affected by the strategy. It calls for the achievement of inter-agency cooperation by means of a joint brief to a number of central government agencies to develop effective environmental measures. As work on this strategy has progressed, three areas of cooperation have emerged with particular clarity: the regulatory frameworks for products, chemicals and waste; collaboration within the food supply chain; and cooperation in the construction, property and civil engineering sector.

One success story is the Swedish substitution work of dental amalgam. In some European countries use of amalgam is still subsidized. The Swedish work to decrease mercury emissions also involve activities at crematories, which has led to a decreased atmospheric deposition.

In this chapter just a few examples of municipal voluntary initiatives have been described, but these examples demonstrate that municipalities have several opportunities to successfully implement voluntary measures. Often these are close to legislation. An important measure focussed towards point sources is the operational oversight and regulatory guidance, which ensure that different actors in the municipality follow the relevant laws and rules. The municipalities can decide how much of their resources to allocate to this kind of work. Economic subsidizing, green procurement or just information or communication with local actors all offer important opportunities to decrease emissions through voluntary activities.

4 Green Procurement

4.1 The Mayor of London's Green Procurement Code

Green procurement is an environmentally responsible approach to purchasing products and services. As a concept, it promotes consideration of environmental impacts in all stages of procurement, from avoiding buying unnecessary products to selecting items which can be reused or recycled and considering the environmental credentials of any contractors you hire. Green products can be identified as those which use fewer natural resources, contain fewer hazardous materials, have a longer life-span, consume less energy, can be recycled and/or generate less waste e.g. in terms of packaging. However, green procurement also incorporates the supply and provision of services, with it being possible to integrate environmental considerations into the selection criteria for contracting in and out services, from catering to construction (Mayor of London's Green Procurement Code, 2007).

London businesses are reported to produce approximately 100,000 tonnes of waste each year, with waste typically costing companies 3.4% of their annual turnover (Green Procurement Guide, 2007). For example, of the 4.8 million tonnes of printing paper used in the UK per year, 86% ends up in landfill or being incinerated (Brother, 2008). As one of the world's major cities, the combined purchasing power of London's business sector is seen as a potentially highly influential tool in both tackling the city's waste management issues as well as reducing its carbon emissions.

4.1.1 Implementing the Mayor of London's Green Procurement Code

The Mayor of London's Green Procurement Code is a London-based initiative providing free support to all public, private and third sector organisations within the London area who wish to reduce their environmental impact. The programme is financially supported by the London Development Agency (the Mayor's agency responsible for ensuring sustainable economic growth in London) and

implemented by London Remade (a not-for-profit organisation focussing on the development and implementation of environmentally sustainable business solutions).

Figure 15: Image from the Mayor of London's Green Procurement Code

The Green Procurement Code provides practical advice to support companies in integrating environmental considerations into all aspects of their business. It provides extensive on-line support through its website (go to www.greenprocurementcode.co.uk) providing simple, practical guidance on sourcing green products and suppliers. Companies are asked to sign-up to the Green Procurement Code through its website which enables them to access tools and 'know-how' in successfully implementing green procurement practises. Signing-up to the code requires a company to commit to gaining management support in making progressive reductions in their environmental impact. Members are then awarded bronze, silver or gold awards depending on their performance.

It emphasises that price need not be a barrier to implementing this approach, with many products being comparatively priced. It also points out that as green procurement is linked closely to waste minimisation and that with less goods being utilised costs contributing to further cost savings.

As well on-line guidance, on signing-up to the Code businesses receive access to a forum for posting questions, news letters and invites to participate in web-chats hosted by industry experts as well as other green procurement events including twice yearly opportunities to meet green suppliers and compare 'best practice' with other London businesses. Registered organisations are also required to complete a progress review each year to help assess each company's performance in reducing its environmental impact through green purchasing. For companies to be eligible for a gold, silver or bronze award, this review needs to be audited by an Institute of Environmental Management and Assessment (IEMA) registered auditor. Companies can submit this performance review form at any time and receive specific feedback from London Remade on areas in which they are performing well as well as identifying areas which require improvement.

4.1.2 Results and Discussion – Impact of Mayor of London's Green Procurement Code

Since the launch of the Green Procurement Code in 2001, registered members have diverted 1.3 million tonnes of waste from landfill and spent £379 million on green products (Green Procurement Code, 2007). In 2006, actions of Code led to carbon dioxide savings of 175,000 tonnes (equivalent to the annual emissions of over 29,000 households). Many of these savings came from business decisions to buy recycled products including 19,150 square metres of recycled carpet, 15,582 items of recycled furniture and 35,550 recycled printer cartridges (data for 2006) (Green procurement Code, 2007). The growing green product is reflected in the increasing number of suppliers, with Code members purchasing products from 244 different suppliers in 2006 in comparison with 125 different suppliers in 2005.

5 Education – information to specific users

5.1 The Voluntary Initiative (Reducing the Environmental Impacts of Pesticides)

Following on from the use of voluntary initiatives by the European Crop Protection Association (ECPA) to promote the use of best management practices relating to plant protection products (see Section 2.2); this section describes a voluntary-based approach to reducing the environmental impact of pesticides within a UK context.

5.1.1 Background of VI's Pesticide Campaigns

Following a request from the UK government to consider alternatives to the introduction of a legislative pesticide tax, the UK Crop Protection Association, together with a range of stakeholder organisations, proposed a 5 year programme of voluntary measures (VI, 2005). Following public consultation the UK Government gave its support to implementation of this programme, known as the Voluntary Initiative (VI), which commenced in 2001.

The central aim of the VI is to minimise the environmental impact of pesticides and includes over 30 different voluntary actions aimed at addressing the issues from a variety of perspectives. Within this context, key initiatives include:

- The use of Crop Protection Management Plans – a self-assessment form to support farmers in assessing the risks associated with crop protection on their farm
- Development of a National Sprayer Testing Scheme (NSTS) – a programme to ensure spraying equipment is correctly maintained and applies pesticide without spillage or leaking
- Development of a National Register of Sprayer Operators (NRSO) – provides training and information to sprayers to promote their continued professional development
- Implementation of the Water Catchment Protection Project - a collaboration between the farming, crop protection and water industries to 'show case' success within the initial 6 case study catchment areas and promote dissemination of best practices on a national scale
- Indicator Farms Project – established to provide case study data on the environmental impacts associated with implementation of the VI.

A further related initiative has been the UK Crop Protection Association's "H_2OK? Think Water" campaign, a national initiative to disseminate 'key best practice stewardship' through the distribution of posters, leaflets and cab cards. Further important components of the campaign are a special newsletter for sprayer operators and the "H_2OK? Think Water" Operator Road Shows which provide operator training on water protection (see Figure 19).

Figure 16: Logo for the "H_2OK? Think Water" campaign and supporting advertising images

5.1.2 Communication of VI's Pesticide Campaigns

Communication of information to farmers and all stakeholders at the water catchment level is central to the VI resulting in the generation of information and publicity material in a variety of formats. The key message being communicated is that pesticides are a problem, that part of the problem is caused by agricultural practices but that there are simple inexpensive solutions to addressing the issues. Information is circulated and shared through the distribution of free weekly advice by email or text messages, local newsletters providing updates on project progress and local meetings on specific topics where attendees gain new knowledge or skills.

A particular emphasise is placed on the communication of information on the impacts of wet weather and associated ground conditions on the quality of receiving waters. Within this context, text messaging farmers, sprayers and agronomists on current ground conditions and the impact of spraying have been well received (See Figure 17)

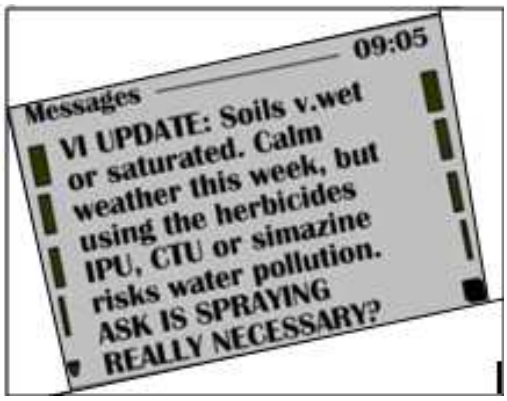

Figure 17: Example of advisory text message to farmers, sprayers and agronomists taking part in the VI

This initiative is seen as being strongly linked to achieving compliance with a range of European requirements, from the EU Drinking Water Directive to the EU Water Framework Directive and the WHO guidelines for drinking water (Directive 98/83/EC, Directive 2000/60/EC & WHO, 2006).

5.1.3 Results and Discussion of VI's Pesticide Campaigns

On completion of the 5 year programme, all of the Government-set targets has been achieved or exceeded, with experience in various catchments suggesting that it takes approximately 15 months for positive results to be seen. In relation to water quality, monitoring data indicates that the use of farmer-led initiatives can lead to an improvement in water quality of over 90%. For example, in one catchment area the number of days in which the water quality standard for pesticides was exceeded was reduced by 98%. However, this level of success was not achieved in all areas with little progress in reducing total pesticides reported for one catchment and only reductions in one particular pesticide reported in another. The reasons behind this differential success are not clear but factors such as the degree of local stakeholder engagement, weather pattern and soil management practices are put forward as highly influential factors.

In relation to changing practices, over 80% of arable land is now sprayed using NSTS tested equipment operated by NRSO members (VI, 2007). Crop Protection Management plans have been returned for 36% of arable land (although the report states that the actual number of these forms completed and not returned is thought to be in excess of this figure) with an increasing number of agronomists gaining Biodiversity and Environmental Training for Advisors (BETA) qualifications.

6 Information Campaigns

6.1 The Scottish WaterSense Initiative (Your home, Your water, Your environment)

WaterSense is a Scottish initiative which aims to raise public awareness of the toxic chemicals used in everyday household products and their environmental impact. The action is a partnership between the WWF Scotland, the Scottish Executive, the Scottish Environment Protection Agency (SEPA) and Scottish Water.

A central resource is the WaterSense website at www.watersense.org.uk/index.php (see Figure 18). This user-friendly website explains how a variety of chemicals used in a range of household products (from toiletries to cleaners) can have a severe environmental impact. It describes how this is because what we put down our drains can end-up in the water environment; either as a result of wastewater treatment plants not being able to remove certain chemicals (partially or completely) or because stormwater drains directly discharge into receiving waters with limited, if any, treatment. The issue is put in context by explaining how many of Scotland's waterways and lochs are national treasures which need to be cared for and clearly makes the link that between what is put into wastewater at home and the quality of receiving waters.

As a headline example of how individual actions can impact on receiving waters, the WaterSense website reports on how the disposal of 250 ml of chlorpyrifos into an English river in 2001 led to the death of hundreds of fish and wiped out aquatic insects along a 20 km stretch of the river. It then goes on to explain what chlorpyrifos is, and that even though you might not have heard of it, you may well have used it as it's a common component in insect killers and vermin bait. It them provides advice on how safe use and disposal.

Figure 18: Logo from the WaterSense website

Through its website WaterSense provide information on particular chemicals of concern and their impact, as wells as providing practical advice on what people can do to minimise their impact on the water environment. The website includes a section called 'around the home' in which website users can click on various rooms to find information on the types of chemicals found in commonly-used products together with advice on their purchase (is it necessary? Are safer alternatives available?), use (don't use more than is really necessary) and disposal of household products. A real emphasis is on encouraging the public to read ingredient labels and, where possible, select safer alternatives.

The website includes a 'chemical glossary' which provides specific information a range of chemicals of particular concern, including the following EU WFD priority pollutants: nonylphenols, chlorpyrifos, atrazine, simazine and DEHP. Similar information is also included on several 'emerging compounds' such as triclosan and artificial musks.

6.1.1 WaterSense in Forfar Loch

A key campaign launched by WaterSense has focused on algal blooms which occur in Forfar Loch (in the East of Scotland) due to an excess of phosphates being discharged into the loch. Although phosphates can come from a variety of sources (including runoff from areas of agricultural), high phosphate input into Forfar Loch can be directly linked to household use of phosphate-containing detergents as the loch is located at the top of the catchment and receives little, if any, agricultural runoff. The website explains the negative impact of algal blooms on wildlife and humans and explains

that its source (in this case) are phosphates contained in washing powders, liquids, tablets and sachets and dishwasher tablets, powders and gels. Phosphates are included in detergents to soften the water and to 'hold back' the dirt. However, the website notes that as most waters in Scotland are already soft, its inclusion for this purpose is not necessary.

The emphasis of this campaign is therefore to promote the use of phosphate-free washing powders and tablets in the Forfar area. The concentration of phosphates can vary from 0-30% between different products, and the campaign is asking shoppers to check labels and choose products containing phosphates at a concentration of 5% or less or to choose ecological brands which are 100% phosphate-free.

WaterSense in Forfar has developed educational literature focussing on involving local schools in the campaign which includes suggestions on how to link the initiative into various modules required by the national curriculum, as well as identifying how the project can feed into the achievement of cross-curricular themes. The website also includes a 'cool stuff' section for children which includes a 'From Sock to Loch' cartoon poster describing how phosphates can travel from your washing machine to the loch (see Figure 19), colouring sheets and stickers, all available for free.

Figure 19: Snapshot from the 'From Sock to Loch' poster

6.1.2 Results and Discussion Forfar Loch Initiatives

An initial survey conducted as part of the campaign launch in 2005 concluded that awareness of phosphates and their impact on Forfar Loch was low. However, the results of the interim survey conducted a few months later suggested the campaign was successful in disseminating information, with the number of respondents who had heard of phosphates increasing from 24% to 67%, and awareness of the link between chemicals and algal blooms increasing from 38% to 67% of responders. Appreciation of the link between household use of products and water quality also showed an increase from 30% to 47%. However, although successful in disseminating information, the same survey indicated that the campaign has not had the same impact in relation to changing shopping habits with the number of people purchasing high-phosphate washing powders showing an increase of 4%, equating to 19% of the local population. The campaign organisers identify improved branding by retailers (to make it easier to recognise low-phosphate detergents) as an important next step in helping to change shopping habits.

6.2 The Scottish Oil Care Campaign

The Scottish Oil Care Campaign is an initiative launched in 1999 by the Scottish Environmental Protection Agency (SEPA), Scottish Water and local communities with the aim of informing and encouraging good practice to help prevent oil pollution. The drivers behind this campaign were reports that oil is the cause of 20% of water pollution incidents in Scotland (SEPA, undated), with 40% of these events being the result of oil entering a watercourse from a surface water outfall or drain (Ellis, 2005). Oil can have both an acute and chronic toxic impact on receiving water ecology, with 1 litre of oil able to pollute 1 million litres of drinking water and 0.5 litres of oil being sufficient to stop a small sewage treatment plant from operating (SEPA, undated).

Following on from the recognition that common sources of oil pollution include leaks and spills, inadequate storage facilities and poor disposal practices together with the fact that many people seem unaware that stormwater drains directly discharge to the nearest river, the Scottish Oil Care Campaign was developed along two main foci:

- The Oil Care Code aimed at disseminating information on the safe delivery, storage, use and disposal of oil
- The Yellow Fish Campaign to target the pouring of unwanted oils and other chemicals down drains

6.2.1 The Oil Care Code

The Oil Care Code focuses on ensuring that information on the safe use and disposal of oil is highly visible to users through its presence on a range of oil-related products from oil containers and filters to car manuals and storage tanks. Further information on Scottish regulations regarding a range of storage aspects, together with a variety of helpline telephone numbers, can also be accessed on-line at the Oil Care Code website (http://oilcare.org/).

6.2.2 The Yellow Fish Project

The Yellow Fish Project aims to raise awareness of oil pollution and methods for its prevention in local communities in an active and enjoyable way. The project involves groups of local volunteers marking drains with a stencilled yellow fish to remind people that many drains connect directly to streams and rivers (see Figure 21). This action is further reinforced by the distribution of leaflets within the area where drains have been marked together with posters and local media coverage promoting the key message “Dispose of your liquid waste responsibly – not down any drain”.

Figure 20: Logos and images from the Yellow Fish Project Photo credit: www.sepa.org.uk/yellowfish/index.htm

To support implementation of these schemes the Yellow Fish Project website (www.sepa.org.uk/yellowfish/index.htm) list locations of where the project has been implemented and makes suggestions of who can be involved (e.g. schools, youth clubs, sports clubs, businesses, community groups etc; see Figure 22) together with providing full information on how to start your own project. This includes comprehensive guidance, all equipment free-of-charge and further advice/guidance from a SEPA member of staff if required.

Figure 21: Images from Yellow Fish Projects

6.2.3 Results and Discussion of the Yellow Fish Projects

Although the impact of such campaigns is hard to quantify, it is suggested that such initiatives do have a positive impact in terms of reducing the pollution loads entering receiving waters. In particular, it is understood to reduce the input of litter, waste oils, garden chemicals and fertilisers. Further success is also associated with the fact that the campaign actively involves communities in protecting their local watercourses and is successful in working with all age groups.

6.3 Battery Recycling in the UK – the WRAP Battery Collection Initiatives

The Waste and Resources Action Programme (WRAP) is a UK government-sponsored organisation which works with local authorities, businesses and individuals to reduce waste and increase levels of recycling. It is involved in a raft of initiatives, which closely link the benefits of increased recycling with reducing carbon emissions and providing economic benefits. For example, in its 2008-2011 business plan, WRAP's three 'headline targets' are to divert 8 million tones of waste materials from landfill, to save 5 million tones of CO2 equivalent emissions and deliver £1.1 billion (€1.38 billion) in economic benefits to business, local authorities and consumers (WRAP, 2008d).

With a view to meeting the requirements of the EU Batteries Directive (requires the collection of 25% and 45% of household batteries by 2012 and 2016, respectively), WRAP has been working closely with local and national governments throughout the UK to develop and test alternative approaches to increasing the recycling rate of household batteries. Research reported by WRAP suggest that around 600 million batteries are sent to landfill in the UK, with the average UK household using 21 batteries a year in a range of common devices from alarm clocks, to smoke alarms and mobile phones (WRAP, 2008a). In the UK only 0.5-2% of batteries are collected for recycling, in contrast to a range of 15 – 59% for Spain and Belgium, respectively (2002 data).

Through WRAPs scheme, all non-lead acid single use and rechargeable batteries can be recycled. A key aspect of battery recycling is the sorting process in which batteries of differing chemistries are identified and separated into the following main groups:

- Alkaline/Zinc Carbon
- Nickel Cadmium
- Nickel metal hydride

- Lithium ion rechargeable
- Single use Lithium
- Button cells (Mercury and Silver Oxide)

In the UK, battery sorting is primarily a manual process, with an experienced battery sorter reported to be able to process approximately one tone of batteries per day. In larger sorting facilities (e.g. those receiving in excess of 5000 tonnes per day), the use of automated sorting equipment becomes cost-effective utilising various techniques including electromagnetic properties or x-rays in combination with battery mass to identify differ battery chemistries. However, such automatic processes are reported to have problems in distinguishing between batteries and certain contaminants (such as bullets) and hence the use of automatic sorting processes is not universally supported.

Whilst most battery types can be fully or partially recycled in the UK, Ni-Cd and single use Lithium are transported abroad for economic reasons (reduced use of Ni-Cd batteries and current low level of use of Li batteries in both cases means there are insufficient quantities of these battery types to support an economically viable UK-based recycling plant).

Table 1 Constituents of a range of main battery types (WRAP, 2008b)

Battery type	Key constituents
Alkaline/Zinc carbon	Fe, Mn, Zn, Hg*
Li ion rechargeable	Fe, Co, Ni, Cu, Li
Ni-Cd	Fe, Ni, Cd
Ni metal hydride	Fe, Ni, Co

*Newer alkaline and zinc carbon batteries may contain significantly lower amounts of Hg or none at all (Colorado Department of Public Health and the Environment, 2002)

The WRAP battery programme is the biggest household battery recycling scheme in the UK to-date, and involves trialling the effectiveness and costs of various types of collection schemes (WRAP, 2008c).

6.3.1 Results and Discussion – Kerbside Battery Collection Trials

This scheme commenced in March 2006 and involves WRAP working with 12 partners in 13 local authorities across the UK. Within the scheme, 350 000 households were provided with either a box or sealable bag to store batteries prior to their collection as part of the routine collection of other recycling waste.

Data collected from on the first 9 months of the trial reported that 27.2 tonnes of household batteries were collected (equivalent to over 1 million batteries). Feedback from both battery collectors and householders on their experiences of the scheme was generally positive, with one partner reporting that the numbers of batteries being collected was consistently 300-400% of that volume expected.

Figure 22 Image from the WRAP battery recycling campaign (photo credit: wrap.org.uk)

6.3.2 Results and Discussion – 'Take back' Trials

The 'take back' battery trials commenced in late 2006 in 33 stores located in England and Wales, with similar trials commencing in Scotland in late 2007. The initiative involved the location of battery collection containers in a variety of participating stores to enable shoppers to drop off unwanted/used batteries.

Initial analysis of data collected indicates that after a slow start (due to customers being unaware of the scheme) the majority of stores have collected more batteries than anticipated. The scheme is reported to be well received by staff and customers, with customers making a conscious effort to drop-off batteries when shopping. Over a 5 month period (October 2006-February 2007), 642kg of batteries were collected with this number anticipated to rise as customer awareness of the service grows.

6.3.3 Results and Discussion – 'Drop off' Point Collection Service

The 'drop off' point battery recycling scheme aims to facilitate the collection of batteries by providing recycling containers at various sites located throughout a specific area. The scheme has just been launched in to 2 local authority areas and involves the placing of battery collecting bins at 46 locations in the borough of Camden and 24 locations in the local authority area of Cherwell. Results on the success of this scheme are not yet available.

6.4 Battery Collection in Sweden

6.4.1 Collection of Discarded Batteries

In Sweden batteries are also collected due to their content of heavy metals; cadmium, mercury and lead (Batteriinsamlingen, 2007). Since it is difficult for consumers to differentiate between different types of hazardous batteries, Sweden decided that all batteries are to be returned. This is to avoid any batteries or products with built-in batteries being thrown away with household refuse. According to the Swedish Battery Ordinance (1997:645, launched in 1 January 1998), all municipalities are required to organize systems for collecting discarded small batteries. The municipalities shall ensure that the batteries are sorted and taken to reprocessing or final disposal. They should also inform retailers and consumers about how the local collection system is organized, i.e. where the batteries can be returned. Sweden has 290 municipalities, each of which determines its own collection system for small batteries. Some municipalities apply a kerbside pick-up system, which means that batteries and other types of hazardous waste are picked up directly from the household. But most municipalities have chosen to set up collection boxes at recycling stations, where there are also special bins for newspapers and paper, plastic, metal and glass packaging. Industrial batteries are collected by those who sell them. The same applies to starter batteries, which are also collected by service stations and auto repair shops. Collection is administered by Returbatt, whose mission is to formalize and

rationalize the collection of lead-acid batteries in Sweden and the recycling of lead. According to the Battery Ordinance, retailers are required to inform consumers where they can return used batteries to. Those who sell products with built-in hazardous batteries are furthermore required to take back such products when they are no longer required, and to see to it that they are taken to a collection station designated by the municipality. Those who sell lead-acid batteries weighing over three kilos are required to take back the batteries and make sure that they are taken to an approved reprocessing plant.

Consumers are required to turn in all spent batteries to the municipality's collection system, or to retail outlets that take back batteries. Products with built-in hazardous batteries must be returned to the place of purchase or to the collection station designated by the municipality at their end of life.

Anyone who professionally manufactures or imports hazardous batteries to Sweden is required to pay a fee and furnish information to the Swedish EPA regarding the quantity of batteries transferred to another party or imported for their own use in a professional operation. This requirement also applies to anyone who professionally manufactures or imports to Sweden products containing hazardous batteries or products accompanied by such batteries. The fee is intended to pay for:

- disposal or recycling of hazardous batteries,
- information that needs to be disseminated to achieve the purpose stated in the Ordinance,
- the municipality's sorting of hazardous batteries,
- collection of lead-acid batteries,
- the Swedish EPA's processing of the data to be provided regarding hazardous batteries.

The fee is payable to the Battery Fund, which is administered by the Swedish EPA.

6.4.2 Treatment of Discarded Batteries

Mercury batteries are sent to SAKAB AB, which processes the mercury contained in them. The cost of this reprocessing is paid for out of the Battery Fund. Importers of batteries that contain mercury are required to pay a fee to this fund. By the end of 2007, the Battery Fund contained about SEK 80 million for the management of mercury batteries. SAKAB AB will recover 98 percent of the mercury. According to one proposal, the recovered mercury will not be recycled but safely disposed of in an underground repository. Nickel-cadmium batteries and nickel metal hydride batteries are transported to SAFT AB in Oskarshamn (Sweden). There both cadmium and nickel are recovered. Recovered cadmium is employed in the manufacture of open nickel-cadmium batteries for industrial use. The recovered nickel goes to steel mills. Nickel metal hydride batteries contain nearly 50 percent nickel, and there are companies interested in salvaging these batteries for their metal value. The lead-acid batteries are taken to Boliden Bergsöe, a recycling company, in Landskrona (Sweden) for reprocessing. Recovered lead is sold to manufacturers of lead-acid batteries, amongst other users. Lead is a serious environmental concern and will be phased out of the material cycle in the long term. However there is currently no viable alternative to lead in applications such as starter batteries for cars. Alkaline batteries and manganese dioxide batteries are disposed of in landfills for the time being.

6.4.3 Battery Collection Information Campaign

Battery collection began in Sweden in the 1970s. In conjunction with the initiation of the new Battery Ordinance in 1997, the Battery Collection Project was started as cooperation between

- The Swedish EPA
- The Swedish Association of Local Authorities and Regions (SALAR)
- RVF – The Swedish Association of Waste Management
- The Swedish Battery Association.

The Battery Collection Project's mission is to disseminate information on the requirements of the Battery Ordinance. This information is primarily aimed at the municipalities, but also at the public. The Battery Collection Project also supports the Swedish EPA, which is responsible for coordination.

The Battery Collection Project started an information campaign in 1999 to raise awareness among the public about where to return used batteries. The goal of the campaign is to ensure that nobody throws away batteries with their household refuse. Nor should used batteries be stored at home; they should be returned for collection. Another important mission is to raise awareness regarding the kind of products which contain built-in batteries. This national campaign is intended to support the municipalities with their information campaigns, collection and sorting of batteries. A free information kit has been produced to assist municipalities. The kit will complement the municipalities' own information efforts.

The information campaign is intended to reach the entire Swedish population, households, large-scale consumers, all fifth-graders and, consequently, their families and teachers.

The campaign "Hem till holken" (roughly: "Home to the nesting box" – The Swedish battery collection boxes are called "nesting boxes") started in the autumn of 1999. The campaign's messengers were animated battery characters who appeared in various TV films and wanted nothing more than to go home to their nesting boxes. The campaign attracted a great deal of attention among both the public and the media. 70 percent of those who had seen the campaign were very positive to the message.

In the autumn of 2000, the country's fifth-graders took part in a competition to manufacture and decorate existing battery collection boxes. With the help of a group of teachers a school information kit was also produced for use in the instruction of intermediate-level pupils. Teachers receive an annual offer to order the material free of charge. The animated battery characters also appear in the school information kit, which can be ordered free of charge by teachers and reaches about 25 percent of all intermediate-level pupils every year.

Free material for pre-school children has also been produced. The material is based on the same animated battery characters as the school material, and is designed to suit 3-5 year olds, including a memory game, an A-Z pointing board, a story book and teaching materials. In 2005 the material was sent out to 67,000 pre-school children.

In order to disseminate information about built-in batteries, a nationwide campaign was conducted in 2001 and 2002 on the theme "The most dangerous batteries can't be seen". Since built-in batteries can't be seen, there is a great risk that they will end up in household refuse when the products are discarded. X-ray pictures of products with built-in batteries – toys, teddy bears and electric toothbrushes – were posted on 8,000 billboards in several cities. The Battery Collection Project was first in Sweden to use billboards with sound. The follow-up poll showed that more people were able to name products with built-in batteries after the campaign than before. When polled, people predominantly mentioned products that had been shown on the billboards, thereby confirming that the message had been received. The Battery Collection Project also received enquiries from the public, who wanted to have the posters for their own use, which is rather unusual. The publishing house Natur & Kultur also bought the pictures to use them in their educational textbooks.

6.4.4 Results and Discussion of Swedish Battery Management

The Battery Collection Project currently has a number of communication channels for conveying its information. In addition to the information campaigns and the website, there is also a special telephone number for the Battery Collection Project's information office which people can call for further information. From statistics on sold amount of batteries it can be seen that during the 10 year period from 1997-2006 98% of Ni-Cd batteries and 82% of the Pb batteries were collected. In the period 1999 to 2006, more Hg batteries were collected than sold (128%), showing that more information is

needed or that a longer period has to be looked at to get enough information for a robust statistical evaluation to be undertaken. This example is not a voluntary initiative, as legislation gave the basis for this work. However, it is included in this report as it is an example of an information campaign. From the 1 January 2009 a European directive (2006/66/EG) will be implemented in Swedish legislation and this will result in a change in responsibility of battery collection and treatment to producers. This directive states that cadmium containing batteries should be phased out and that all kinds of batteries should be collected. Although the Swedish legislation and way of handling this question before this date has been rather well fitted to this directive, a new requirement is that all kinds of batteries should be recycled and not only collected as before. Batteries with cadmium have been more or less phased out already as lithium ion and nickel metal hydride batteries are cheaper due to an environmental fee added to the price of cadmium batteries in Sweden.

6.5 Computers in the UK – the Ecochip Computer Reuse and Recycling Facility

As information technology continues to rapidly evolve, computers (and associated support equipment) typically have increasingly shorter life spans, with many becoming obsolete after only a few years as users either require or want the latest technological developments. In the UK it is reported that 39% of electrical wastes arising consists of information technology (IT) equipment (equivalent to 357,000 tonnes), with computers contributing to the majority of this mass. In 2000, only 26% of IT equipment was recycled (Waste Online, 2005).

Although the Waste Electrical and Electronic Equipment Directive (WEEE Directive, restricting the use of hazardous substances in electrical and electric equipment, Directive 2002/95/EC, and promoting the collection and recycling of such equipment, Directive 2002/96/EC) has major implications for importers, producers and retailers of electrical and electronic equipment, there is no mandatory requirement for householders or Local Authorities to separate out WEEE (Waste Online, 2005). Whilst the demand for refurbished computers has increased by 500% over the last decade, this equates to the reuse of less than 20% of discarded computers with a reported 2 million working Pentium computers end up in landfill sites every year (Waste Online, 2005). It is suggested that as the amount of batteries (including car batteries) entering the waste stream has fallen, WEEE now contributes the largest load of heavy metals to the waste stream (USEPA, 2000).

In the UK, there are a variety of organisations which support both businesses and individuals in recycling unwanted computers and associated IT equipment. Whilst these organisations state a variety of objectives in carrying out this work (such as supporting the work of charitable organisations), such initiatives provide a key opportunity for reducing the amount of electrical equipment (and associated priority pollutants) being disposed of in landfills as well as increasing the levels of IT equipment entering the recycling chain. Table 2 lists constituents of possible concern reported to be present in a range of computer components.

Table 2 Constituents of possible concern in various computer parts (AEA Technology, 2004)

Component	Constituent
Computer housing	Decabromodiphenyl oxide (PBDE no longer used in EEE applications but probably present in older equipment)
Circuit boards	Tetrabromo-bisphenol A, Cu, Pb/Sn solder, Hg, Sb, Be,
Components containing plasticisers	Dibutyl phthalate, diethylhexyl phthalate
Cathode ray tubes	Pb, Sb, Hg, P, As*

*LCD screen (AEA Technology, 2006)

An example of a computer reuse and recycling organisation is 'Ecochip', a non-profit making company which to eliminate the disposal of computer equipment at landfill sites (see Ecochip website at www.ecochip.co.uk/). Ecochip is based in London but covers the whole of the UK, collecting unwanted equipment from both companies and households. On receipt of goods, Ecochip assesses whether the computer can be reused and, if so, fully refurbishes the machine before passing it on to a 'second user' such as a charity, school or student. If the computer can not be reused, machines are broken down and materials passed on to plastic, glass and metal recyclers. No data is available on the number of computers collected, refurbished or recycled.

6.6 Recycling Mobile Phones in the UK - the Foneclub Initiative

It is estimated that in the UK, approximately 90 million unwanted mobile phones are currently in circulation (equating to 2 unwanted phones per household). Although on average UK users update their mobile phone every 18 months, only 5% of old phones are reported to be recycled. The exact composition of mobile phones differs from model to model, with various makes of phones likely to contain differing amount and types of specific substances. However, the general composition of phone is reported to be similar across all mobile phones with a range of typical constituents of various mobile phone components reported in Table 3 (UNEP/Basel Convention, 2006).

Table 3 Typical constituents of mobile phone components

Components	Constituents
Case	Al, Fe, Cr, Ti, Sb, mg
Circuit board	Cu, Sn, Br, Pb, Mn, Ag, Ta, Zn, W, Ba, Bi, Ca, Au, Pa, Ru, Sr, S, Y, Zr
Battery*	Ni, Co, Li, C, Al, Fe, Cd, F

*Dependent on battery type; see Table 1.

When disposed of as part of general household rubbish, mobile phones generally end up in a landfill and such substances can leach into the surrounding environment (e.g. as illustrated using a Foneclub publicity cartoon shown in Figure 23).

Figure 23 Image to support the UK Foneclub mobile phone recycling initiative (photo credit: www.foneclub.co.uk)

Foneclub is a fund-raising mobile phone recycling initiative run by Corporate Mobile Recycling Ltd (CMR) which works with individuals, businesses and charities to collect unwanted mobile phones. CMR pays £2.50 for each handset collected (regardless of its condition) with money raised going to

either one of CMR's partner charities (currently Oxfam, Shelter, Water Aid and Amnesty International) or a charity specified by and individual or company subscribing to the Foneclub scheme.

All information on establishing a scheme is available on-line at www.foneclub.org.uk. On registering with Foneclub and identifying the charity of your choice, Foneclub provides a range of supporting information to the initiative organiser (from posters to press releases) to publicise the campaign locally. Foneclub also provide recycling bags for the receipt and storage of phones. Less than 30 handsets can be sent to Foneclub using a freepost address; if over 30 handsets are collected, Foneclub will collect handsets free of charge.

6.6.1 Results and Discussion of Recycling Mobile Phones in the UK

CMR report they recycle over 75,000 handsets per month (Foneclub, 2007). Of these phones, approximately 70% are functioning or repairable, and most of these phones are sold and reused in developing countries where installing a land-line can be too expensive. The remaining 30% are dismantled and their parts reused or recycled in accordance with ISO 14001 and EMAS accreditation (Council Regulation (EC) No. 761/2001: March 2001).

6.7 Artist Paints with Cadmium – Information Campaign in Stockholm, Sweden

Connected to the goal described in section 3.1.2 "The City shall work towards a reduction of at least 30% in the use of art paints containing cadmium" the major wastewater treatment plants in Stockholm implemented an information campaign in 2001, after having found out that cadmium from artist paints could be an important source of cadmium in sludge (Stockholm Vatten, SYVAB and Käppala, 2001). Art schools, studios and retailers were contacted and visited and a short and simple information pack was produced containing information on:

- how many kg cadmium reach the wastewater treatment plants per year
- that cadmium is harmful to man and the environment
- where to leave waste containing paint
- that this waste should be marked with information that it contains cadmium
- where to call to get more information

Figure 24 Swedish information material telling that cadmium is harmful for man and environment used in contacts with art schools, studios and retailers. (Stockholm Vatten, SYVAB and Käppala, 2001)

6.7.1 Results and Discussion of the Cadmium in Paint Initiatives

Statistics on the amount of cadmium in artist paints sold showed the campaign had a positive effect (Fig 7). Also the cadmium concentration in biofilms in sewers at art schools decreased (Stockholm Vatten, SYVAB and Käppala, 2003), (although this assessment was based on a limited number of samples only). Looking at a longer time period, sludge concentrations from the two wastewater treatment plants in Stockholm (Fig 8, Cadmium concentration in digested sludge at Henriksdal (to which most art schools are connected), and at Bromma, the second wastewater treatment plant in Stockholm) showed a decrease in cadmium content at both plants. The difference between Henriksdal, the bigger wastewater treatment plant, and Bromma was lower after 2001 providing further support for the success of the campaign.

7 Eco-labelling

7.1 Use of Green Labelling in the UK

A huge range of green labels and claims are currently in use in the UK, and are commonly interpreted to be a way of helping shoppers identify environmentally-friendly products. These labels cover a broad range of sustainability and environmental aspects and it can be difficult for consumers to actually identify what contribution to helping the environment a particular product will make. Many labels apply only to certain types of product or environmental impact. Manufacturers can also use their own environmental logos or make their own 'green claims' but unless these claims are associated with a reputable organisation and are clearly explained, they can be meaningless.

To support consumers in understanding the range of logos available and what they mean, the UK Department of the Environment Farming and Rural Affairs (DEFRA) has produced a 'Shopper's Guide to Green Labels' available at:

www.defra.gov.uk/environment/consumerprod/pdf/shoppers-guide.pdf which gives further information for interested shoppers on a on a range of logos commonly found on products in the UK and provides links to further information.

A more comprehensive document is DEFRA's 'An Index of Green Labels' published in 2008 and available at:

www.defra.gov.uk/environment/consumerprod/glc/pdf/greenlabels-index.pdf. This report provides information on over 80 environmental and ethical labelling schemes. Inclusion in this DEFRA report does not imply recommendation by DEFRA, and it emphasises that the credential of all schemes should be carefully checked before a company considers registering with any scheme.

With so many eco-labelling schemes available DEFRA has produced a guidance document entitled 'Pitching Green' to support companies in choosing between different schemes. This provides information in relation to various schemes' requirements (standards a product would need to achieve to be registered) as well as the type of standards shoppers might be looking for. This document can be accessed at http://ecolabel.defra.gov.uk/pdfs/pitching_green.pdf.

One scheme that DEFRA is highly supportive of is the EU Flower eco-label which is described in the following section.

7.1.1 The EU Flower

Unlike other many other European countries, the UK does not have its own national eco-labelling scheme. Following the establishment of the first eco-labelling scheme in Germany in the 1970s (the Blue Angel), several other countries developed their own scheme with one of the best known schemes being Scandinavia's 'Nordic Swan (DEFRA, 2008). The EU established its own eco-labelling scheme (the EU flower; see Figure 25) in 1992 as a voluntary instrument to encourage the development and

use of greener products. The UK Government's current position is that setting up a national scheme would directly compete with this European initiative and would not be helpful or productive as national schemes take time to become established and are expensive to initiate.

Figure 25 The EU eco-label flower logo

Instead the UK has strongly supported the use of the EU flower from its initial establishment, with the UK being the first country to issue an EU flower label to a product. DEFRA is the EU eco-label competent body in the UK, running the scheme in association with the management consultants TUV NEL (http://www.tuvnel.com/default.aspx). The EU Flower currently applies to 25 product groups and services including fridges, paints and textiles. However, it does not include foods, drinks, cars or pharmaceuticals, with the former 3 product groups being amongst those known to incur the greatest environmental impacts (DEFRA, 2008). Discussions on whether such product groups should be included at a future date are still on-going.

Full information on the EU eco-label scheme in the UK, how it operates and how companies can register is available on the DEFRA website at http://ecolabel.defra.gov.uk/index.htm.

7.2 Use of Green Labelling in Sweden

Unlike the UK but like many other European countries, Sweden (together with the other Nordic countries) has its own national eco-labelling scheme, in combination with the EU flower and other labels. The following sections describe some of these labels (for label symbols see Figure 26).

The Swan (ref: http://www.svanen.nu) is the official Nordic Eco-label, introduced by the Nordic Council of Ministers in 1989, and covers 67 different product groups (data for 2008). The Swan ensures that products fulfil certain criteria using methods such as samples from independent laboratories, certificates and control visits. The label is usually valid for three years, after which the criteria are revised and the company must reapply for a licence. In this way, the Swan ensures that products better suited to the environment are constantly being developed. In this voluntary license system the applicant agrees to follow certain criteria outlined by the Nordic Eco-labelling organisation in cooperation with stakeholders. These criteria include environmental, quality and health aspects which promote the products and services belonging to the most environmentally sound companies and take into account factors such as free trade and proportionality (cost vs. benefits).

KRAV (http://www.krav.se) is a key player in the organic market in Sweden that develops organic standards and promotes the KRAV label. KRAV is organised as an incorporated association with, at present (2008), 28 members. The members represent farmers, processors, trade and also consumer, environmental and animal welfare interests. KRAV owns a subsidiary, Aranea Certifiering AB, which is one of four certification bodies that carry out inspections according to KRAV standards. KRAV is a member of IFOAM (International Federation of Organic Agriculture Movements), an umbrella organisation which gathers organisations for farmers, scientists, educationalists and certifiers from almost every country in the world. KRAV's standards meet the IFOAM Basic Standards and the EEC regulations for organic production. Producers, distributors and processors who wish to use the KRAV

label must be certified by an accredited certification body. The KRAV label must never be printed alone but must always appear in conjunction with the name of the certified producer.

Bra Miljöval (http://www.naturskyddsforeningen.se/In-english/Ecolabelling), the Falcon, referred to as "Good Environmental Choice" in English, is the green label of the NGO Swedish Society for Nature Conservation (SSNC). SSNC started eco-labelling laundry detergent and paper in 1988. Currently the system covers 8 product areas; chemical products, paper, textiles, freight transport, passenger transport, electricity supplies, shops and district heat. Good Environmental Choice is the only system in which requirements are drawn up solely by an independent environmental organisation.

The EU's Flower eco-label was for a long time a fairly uncommon label on Swedish supermarket shelves, but is now common for textiles, interior paint and a range of other products.

The TCO Development label (TCO '95,'99 or '03) is used for example on computers, mobile phones and office furniture to show that they comply with strict requirements regarding the working environment, their impact on the external environment, and that they are energy efficient.

7.2.1 Results and Discussion of Eco-labels Using in Sweden

It may seem confusing that Sweden has several eco-labelling systems, but this diversity has also contributed to the success of eco-labelling as the different systems encourage each other. A benefit of having a national eco-labelling system is that fewer stakeholders are involved. The reason why the EU flower did not turn out to be the most used eco-label in Sweden could be that the introduction of a common eco-labelling system for EU member countries has taken a long time, since all member states had to agree on the form of the criteria and how they should be applied. There has sometimes been disagreement between those who want requirements that are strict enough to lead to real improvements, and those who feel that the requirements should be less strict so that as many products as possible can display the flower. Depending on kind of product the different eco-labelling systems differ in strictness in requirements.

In October 2008 a global study commissioned by the British Government named the Nordic Eco-labelling (the Swan) a world leader. In three of the nine categories the Nordic Eco-label won best practice for its certification of sustainability: "… The Nordic Swan is perhaps the most well-known European eco-label; 67 % of people in the Nordic countries recognize and understand the purpose of the label and it has become increasingly used outside of northern Europe. The cross-stakeholder nature of the criteria development with close cooperation and technical input from industry has ensured a high level of "buy in" from consumers, policy-makers, business and NGOs. Most consumers consider that the label ensure a brand is reliable and of high quality." (http://www.svanen.nu)

A poll in Stockholm (Lindström, 2007) found that most people recognised the most common Swedish or Scandinavian green labels (Figure 26) and there has been an increase in consumption of eco-labelled products (Stockholms stad, 2008b).

	MILJÖMÄRKT	KRAV			TCO'03 DISPLAYS
Yes	96	96	80	29	21
No	2	3	19	69	77
No answer	2	1	1	2	2

Figure 26 Percentage of the general population in Stockholm who recognised various eco-labels (modified from Lindström, 2007).

8 Economic Instruments for the Environment

8.1 Control for hastening the scrapping of older cars – Swedish Car Scrapping Premiums

In Sweden a scrapping premium was introduced on 1 January 1975 to give people an incentive to scrap cars at their end of life. Changes in the value of the premium have been implemented over the years. One change was introduced on 1 July 2001 when the scrapping premium was raised and was also differentiated according to the age of the car. The basic level of the premium was raised from SEK 500 to SEK 700; to SEK 1,200 for cars between 8 and 16 years, and SEK 1,700 for cars older than 16 years. The system was intended to be self-financing whereby the scrapping fee that was paid by the first owner was intended to cover expenditure for the premium that was paid to the car's last owner (Naturvårdsverket, 2004).

8.1.1 Results and Discussion of Swedish Car Scrapping Premiums

With the 2001 amendment to the scrapping premium, changes in the number of scrapped cars can be described as follows: an initial drop, a bulge and a final rising of the level. From the end of 2000 (six months before the introduction of the new system), there was a drop in the number of cars being scrapped. When the premium increase began to take effect, the number of cars being scrapped showed a marked increase. A month or so after the premium was changed, the level went down but the number of scrapped cars still remained at a higher level than in the years prior to the premium increase. In total, this means that during the full year 2001, almost twice as many private cars were scrapped as in the previous year – scrapping remained at the same high level during 2002. In 2003, the number of cars scrapped decreased somewhat but still remained at a level that was higher than the years prior to the change in premium.

However, it should be noted that at the same time several other changes took place that could also have influenced the above result: All private cars up to 3,500 kg were covered by the scrapping premium; the vehicle tax for old diesel cars was raised; in partnership with the municipal authorities, the Håll Sverige Rent (Keep Sweden Clean) foundation introduced a campaign to remove abandoned wrecked cars; administratively scrapped cars were included among the cars eligible for scrapping premiums and new regulations were introduced with stricter environmental requirements for scrapped cars. The fact that all of these occurred at around the same time as the change in premiums made it difficult to use statistical methods to ascertain the proportion of scrappage that was due solely to the changed premiums.

8.2 Reuse of Ink and Toner Cartridges in the UK – the Cartridge World Initiative

In the UK it is estimated that 47 million printer cartridges are thrown into landfill every year, with each cartridge reported to take over 450 years to decompose (Cartridge World, 2008). However, almost all inkjet and toner cartridges can be refilled or remanufactured several times without any impairment of its performance. Within a UK context, it is estimated that a 12 mth toner and ink cartridge recycling programme could save 15 million litres of oil (Cartridge World, 2008).

Cartridge World is a UK-based company with 270 stores located throughout Scotland, England, Wales and Northern Ireland (with additional stores in Cyprus and Malta; www.cartridgeworld.org). It works with both individuals and businesses to collect and refill used ink and toner cartridges, promoting its services as saving consumers money (refilling a used cartridge costs 40% of the cost of buying a replacement) as well as contributing to environmental protection objectives (see Table 4 for constituents reported to be present in ink and toner cartridges).

The company website promotes its business in a user-friendly manner (see Figure 27), using various everyday analogies to get its message across including:

- You wouldn't throw your remote control away when it ran out of batteries would you? Of course you wouldn't. You'd simply replace them.
- You wouldn't throw your kettle away when it ran out of water would you? Of course you wouldn't. You'd simply refill it.

It further re-enforces the 'refill not landfill' message by suggesting that consumers see them as a 'petrol station for your empty printer cartridges'.

Table 4 Reported components of black print cartridges (Lexmark, 2000) and ink and toner cartridges (AEA, 2006)

Constituent	**Reference**
Styrene Butylacrylate Acrylic Acid Copolymer Carbon Black Polypropylene Phthalocyanine Blue Charge Control Agent Silica (Amorphous)	Lexmark, 2000
Cd, Br, Zn, Ti and phthalate plasticisers	AEA, 2006

Figure 27 Image from the Cartridge World 'refill not landfill' campaign photo credit: cartridge world.org.uk

As a business, Cartridge World caters its services to meet both the needs of individuals and businesses. Individual users are to bring their cartridges into one of its stores where it will be refilled, cleaned, tested and packaged for transport home. Additionally, they offer a free collection and delivery service to business users. All customers are offered a 100% money back guarantee if not completely satisfied with their refilled cartridge. As well as refilling cartridges, they can also replace worn parts to promote service life.

9 Discussion

In this report industrial and municipal voluntary initiatives have been described separately as industry and municipalities, often related to governmental decisions, were found to be main actors. To describe different types of initiatives (green procurement, education, information campaigns, eco-labelling and economic instruments) such examples were then described separately. Stakeholders like researchers, NGOs, journalists and consumers have not been specifically mentioned as actors in this report. All these give input, which is often the start of different actions. Research has an important role in voluntary initiatives, as well as in other measures, as a source of information.

Voluntary initiatives undertaken by industry generally focus on directly reducing emissions at production sites, developing good environmental practices for the direct use of their products or act to substitute these substances in their products. This type of initiative should not only be encouraged but also officially recognized by the authorities under certain conditions. The alliance between the PVC producers and the processing industry is a good example of cooperation between chemical manufacturers and their direct downstream users.

The key advantage of the industrial voluntary approach is the commitment of the industry to demonstrate progress and improved image. For industry, the use of voluntary initiatives could be motivated by the potential to generate a positive public image and enhance consumer confidence. By comparison with a legally binding approach, the benefit of voluntary agreements in terms of positive image is much higher, but an external independent audit is an advantage in increasing public confidence in results. Several examples show the efficiency of these initiatives and demonstrate that the industry/business is increasingly engaging actively with environmental issues. The success of these agreements is linked to pragmatic objectives and to the definition of realistic targets. As these efforts are poorly recognised by the authorities, networks and forums for dialogue between authorities and companies need to be established and strengthened, to promote a better understanding of the differing basic assumptions behind the voluntary and the legally binding approaches to shape environmental

efforts. Companies could also contribute knowledge and initiatives which demonstrate that systematic attention to the environment makes economic sense, both for businesses and for society at large.

Companies or industrial associations that are not producers of harmful substances but use them in their products can be a strong actor in voluntary initiatives. These 'second level users' need a specific quality for their products as opposed to a specific substance, and they can decide to change product design or substitute with another substance if their requirements are not fully met. In this report just a few examples of retailers that put specified demands on their upstream suppliers are included; the BASTA work of construction business could be an example and Sony Ericsson producing cell phones and accessories another. There are several other examples of companies that use this opportunity of procurement and with a change in demand the producers will adapt – the market rule (see for example International Chemical Secretariat, 2008).

Information might not directly make people change their behaviour but is essential in most voluntary source control actions, which is also the reason why this kind of initiative has been allowed to take the largest part of this report. As a result, people may more readily accept decisions to increase the cost of certain goods or services, or to limit freedom of choice. But it is difficult to determine the extent to which a given information campaign has changed behaviour and attitudes. As was found in the Hammarby Sjöstad study, information campaigns are more effective when the receivers are involved and can say what kind of information they want and need. Most people are only reacting if they found a particular personal interest. Campaigns aim to convince people that it is their interest.

Several examples of recycling have been described. Often the collecting step works better than recycling, but in order to level out emissions there is often also a need to close the life cycle loop. Waste for recycling is often exported to countries where there are fewer regulations on hazardous substances. An example could be the treatment of plastic components containing flame retardants and/or phthalates that is exported and not taken care of properly.

Many activities described in this report are combinations of different kinds of initiatives. Promoting recycling activities could involve information, education, and also economic instruments, like a reduced price of a new product when you recycle an old one. Environmental goals taken by the government of a country could be close to legislation and regulation. Voluntary initiatives taken by industry could also be combined with the other kinds of initiatives listed in this report and could also be early pre-cursors to legislation and regulation.

There are a huge number of examples of voluntary initiatives, but few of them target a specific PP, which would have made it easier to evaluate their use within a ScorePP context. Another difficulty is to evaluate the outcome of a specific initiative as, even if there are several examples of targets that have been possible to reach, outcomes in terms of economic or actual emission decreases are seldom described.

Adopting voluntary activities could be more rapid than developing technical solutions or developing new legislative measures, as long as those involved benefit from the results. In European cities diffuse sources increase in importances in relation to point sources, which to a large extent earlier legislation have been dealt with. In relation to the management and control of diffuse sources of pollutants such as the use of products, voluntary activities are an interesting way of reducing emissions. Economic instruments, like subsidizing, could be a powerful tool in combination with other voluntary initiatives. Collaboration and dialogue between partners is crucial as measures often depend on the interaction and co-operation of several actors. But to efficiently reduce emissions, work probably has to be done on different levels;

- New, or the more powerful use of, legislation
- Use of economical instruments
- Education, information, green labelling and green procurement to reach consumers

Connected to these, there is also a need to provide incentives for the use of voluntary initiatives by industrial organisations. It is an advantage if the responsibility of reducing emissions is as close to source as possible.

10 Conclusions

Imaginative and effective ways of reducing emissions of pollutants can be developed on the basis of voluntary approaches. These can be encouraged by information campaigns, education initiatives, eco-labelling and other activities. These actions have an indirect effect on emissions because they are generally intended to reduce the use of pollutants-containing products. This mode of source control has clear benefits, with a major advantage being that pollution is avoided.

11 References

AEA Technology (2004) *WEEE and Hazardous Waste: A report produced for DEFRA.* www.defra.gov.uk/environment/waste/topics/electrical/pdf/weee-hazwaste.pdf. Accessed July 2008

AEA Technology (2006) *WEEE and Hazardous Waste: A report produced for DEFRA Part 2.* http://www.defra.gov.uk/environment/waste/topics/electrical/pdf/weee-aeatreport-june06.pdf. Accessed July 2008

Batteriinsamlingen (2007) information found at http://www.batteriinsamlingen.se/ Accessed January 2009

Bromine Science and Environmental Forum (2009) *EU Risk assessment of Deca-BDE* http://www.bsef.com/regulation/eu_risk_assessm Accessed January 2009

Brother (2008) *The Good Office Guide* www.brother.co.uk/display.cfm/id/122411 Accessed 16 October 2008

Cartridge World (2008) *Environment: The facts.* www.cartridgeworld.org/index.php?req=environment. Accessed July 2008

Colorado Department of Public Health and the Environment (2002) *Compliance Bulletin Hazardous Waste Management of Waste Batteries* (reviewed/revised August 2002). www.cdphe.state.co.us/hm/battery.pdf Accessed July 2008

CONCAWE (2004) *Trends in oil discharged with aqueous effluents from oil refineries in Europe 2000 survey* Report No._4/04 (2004) http://www.concawe.be Accessed January 2009

DBP Information Centre (2009) EU Risk Assessments http://www.dbp-facts.com/RA Accessed 12 January 2009

DEFRA (2008) Consumer products: the European Eco-label – frequently asked questions http://ecolabel.defra.gov.uk/faq.htm Accessed 17th October 2008

ECVM (1998a) *ECVM Charter on VCM, Suspension PVC* http://www.ecvm.org/img/db/SPVCcharter.pdf Accessed January 2009

ECVM (1998b) *ECVM Charter on VCM, Emulsion PVC* http://www.ecvm.org/img/db/EPVCcharter.pdf Accessed January 2009

Ellis, JB (2005) *The Scottish Oil Care Campaign*. www.daywater.cz/gfx/bmp/sites/Site37.pdf Accessed 15 October 2008

Euro Chlor (2007) *Chlorine Industry Review 2006-2007. Well-earned reputation rests on renewed sustainability efforts* http://www.eurochlor.org/upload/documents/document268.pdf Accessed January 2009

European crop protection association (2001) *Crop protection products in water through farming practices and farmyard sources- Methods of reduction* http://www.ecpa.eu/files/ecpa/documentslive/23/10439_water.pdf Accessed November 2008

European crop protection association (2005) *The safe use initiative: a European project for farmers' wellbeing* http://www.ecpa.eu/files/ecpa/documentslive/23/14871_SUI_EN_v31.pdf Accessed January 2009

Foneclub (2007) *Fact Sheet 'Phone Facts'*. www.foneclub.org.uk/documents/factsheet.pdf Accessed July 2008

Fränne, Lars (2007) *Hammarby Sjöstad – a unique environmental project in Stockholm.* Glashus Ett, Fortum, Stockholms stad, Stockholm Vatten AB, Hammarby Sjöstad http://www.hammarbysjostad.se/ Accessed 14 January 2009

ICCA (2008) Do all chemical companies belong to Responsible Care – frequently asked questions http://www.responsiblecare.org/page.asp?p=6401&l=1 Accessed 7 January 2009

International Chemical Secretariat (2008) *Substitution 1.0 – the art of delivering toxic-free products* http://www.chemsec.org/publications/business_publ.php Accessed January 2009

Kärrman, Erik, Malmqvist, Per-Arne, Rydhagen, Birgitta, & Svensson, Gilbert (2007) *Utvärdering av ReVAQ-projektet.* Rapport Nr 2007-02. Svenskt Vatten Utveckling. vav.griffel.net/filer/Rapport_2007-02.pdf Accessed January 2009

Länsstyrelsen (2008) *Avloppsslam i Stockholms län. Kvalitet, produktion och användning av slam från tillståndspliktiga avloppsreningsverk i Stockholms län 1981-2006.* Länsstyrelsen i Stockholms län. www.ab.lst.se/upload/dokument/miljo_och_halsa/miljoinformation/Sjoar%20och%20vattendrag/Avloppsslam_AB_lan_2008.pdf Accessed January 2009

Lexmark (2000) *Material Data Safety Sheet: Black Print Cartridge* https://fortress.wa.gov/ga/inet/cs/images/msds/7510-395-312.pdf Accessed July 2008

Lindh, Karin (2006) *Rent avlopp Hammarby Sjöstad - En studie om: avloppsvattnet från den miljöinriktade stadsdelen Hammarby Sjöstad och om information kan påverka hushållens bidrag av främmande ämnen till avloppet.* Stockholm Vatten projektpublikation nr 28, R nr 6, mars 2006 www.hammarbysjostad.se/miljo/pdf/rentavlopp.pdf Accessed January 2009

Lindström, Marianne (2007) *Attityder till farliga kemiska ämnen i varor*. Nya Gifter- Nya verktyg. Institutionen för Naturvetenskap Högskolan i Kalmar, Stockholm Stad http://www.stockholm.se/KlimatMiljo/Kemikalier-och-miljogifter/Nya-gifter---nya-verktyg/ Accessed January 2009

Lützhøft, Hans-Christian Holten, Eriksson, Eva, Scholes, Lian, Donner, Erica, Wickman, Tonie, Lecloux, André, & Ledin, Anna (2008) *Database Presenting Basic Information about EU WFD Priority Substances* Deliverable No: D3.1, Date: 04 September 2007, revised version 04 January 2008 www.scorepp.eu Accessed January 2009

Mayor of London's Green Procurement Code (2007) *What is green procurement?* www.greenprocurementcode.co.uk Accessed 16 October 2008.

Miljöbarometern (2007) http://www.miljobarometern.stockholm.se/mainall.asp?mp=MP&md=2 Accessed January 2009

Naturvårdsverket (2004) *Styrmedel för ökad utskrotning av gamla bilar – Konsekvenserna av senaste ändringar i skrotningspremierna.* Rapport 5414 december 2004, p 18-30 (summery in English) www.naturvardsverket.se/Documents/publikationer/620-5414-7.pdf Accessed January 2009

OSPAR (2009) search for BAT at http://www.ospar.org/ Accessed January 2009

Phthalates Information Centre Europe (2009) *EU Risk Assessments* http://www.phthalates.com/RAs Accessed January 2009

Ravan, Sara (2006) *Guide to non-toxic products - Procurement and purchasing requirements for environmentally friendly products. A guide developed by The Environmental procurement project.* The City of Stockholm. Autumn 2006. Edition 1. http://www.miljobarometern.stockholm.se/main.asp?mp=MP&mo=2 Accessed January 2009

SEPA (undated) *Yellow Fish Guidance Manual* www.sepa.org.uk/pdf/yellowfish/yfmanual.pdf Accessed 14 October 2008

Sony Ericsson (2004) *Environmental Declaration Mobile phone K700* http://www.sonyericsson.com/cws/common/searchresult?lc=sv&cc=se Accessed January 2009

Sony Ericsson (2008) *The Sony Ericsson Lists of Banned and Restricted Substances. Public DIRECTIVE* Document number 2/034 01-LXE 108 239 Uen http://www.sonyericsson.com/cws/common/searchresult?lc=sv&cc=se Accessed January 2009

Stockholm Vatten, SYVAB and Käppala (2001) *Kadmium är skadligt för människa och miljö* www.miljobarometern.stockholm.se/content/pdf/mp/2/kadmium.pdf Accessed January 2009

Stockholm Vatten, SYVAB and Käppala (2003) *Nu är det bevisat! Okända konstnärer är bättre än etablerade* www.miljobarometern.stockholm.se/content/pdf/mp/2/kro_annons.pdf Accessed January 2009

Stockholms stad (2003) *Stockholm's Environmental programme 2002-06* http://www.miljobarometern.stockholm.se/article.asp?mp=MP&ar=240 Accessed January 2009

Stockholms stad (2008a) *Stockholm's Environmental programme 2008-2011* http://www.miljobarometern.stockholm.se/article.asp?mp=MP&ar=240 Accessed January 2009

Stockholms stad (2008b) *Medborgarenkät 2007. Stadsdelsinnevånarna om miljö och miljövanor i Stockholm 2007*. http://www.miljobarometern.stockholm.se Accessed January 2009

Stockholms stad (2008c) *Stockholm – application for European green capital award - 2008-12-05*. http://www.miljobarometern.stockholm.se Accessed January 2009

Swedish Environmental Objectives Council (2008a) *Sweden's environmental objectives – No time to loose*. http://www.naturvardsverket.se/en/In-English/Menu/ Assessed January 2009

Swedish Environmental Objectives Council (2008b) *Sweden's environmental objectives. Appendices to the in-depth evaluation*. http://www.naturvardsverket.se/en/In-English/Menu/ Assessed January 2009

Swedish Environmental Objectives Council (2008c) *Sweden's environmental objectives in brief* http://www.naturvardsverket.se/en/In-English/Menu/ Assessed January 2009

UNEP/Basel Convention (2006) *Guideline on material recovery and recycling of end-of-life mobile phones*. www.basel.int/industry/mppiwp/guid-info/guidmaterial.pdf. Accessed July 2008

USEPA (2000) *WasteWise; update*. www.epa.gov/epawaste/partnerships/wastewise/pubs/wwupda14.pdf ; page 3 Accessed July 2008

VECAP (2008) *Paving the way for REACH. The Voluntary Emissions Control Action Programme. Third annual progress report 2008*. http://www.bsef.com/product_stew/vecap/index.php?/product_stew/vecap/vecap.php Accessed January 2009

VI (2005) *H_2OK? Water catchment Protection*. VI Interim Report www.voluntaryinitiative.org.uk/_Attachments/VI%20Water%20Catchment%20Interim%20Report%20June%202005%20sm.pdf Accessed 14 October 2008.

VI (2007) *Annual report 2006-2007*. VI 6th Annual Report www.voluntaryinitiative.org.uk/_Attachments/VI%20Annual%20Report%202006-07%20lite.pdf Accessed 14 October 2007.

Vinyl (2006) *Vinyl 2010: The voluntary commitment of the PVC industry* http://www.vinyl2010.org/images/stories/vinyl2010_voluntary_commitment.pdf Accessed January 2009

Vinyl (2007) *Vinyl 2010 Progress Report 2007* http://www.vinyl2010.org/images/stories/2007/Vinyl%20report%202007.pdf Accessed January 2009

Wahlberg, Cajsa (2008) *Sammanställning av slamanlyser inom ReVAQ år 2004-2007 SLUTRAPPORT*. R nr 8-2008. Stockholm Vatten AB, Avloppsreningsavdelningen, Utveckling och Investering http://www.stockholmvatten.se/Stockholmvatten/Rapporter/Avlopp/ Accessed January 2009

Waste Online (2005) *Electrical and electronic equipment recycling information sheet*. www.wasteonline.org.uk/resources/InformationSheets/ElectricalElectronic.htm. Accessed July 2008

WHO (2006) *World Health Organization. Guidelines for drinking-water quality incorporating first addendum. Vol. 1, Recommendations. – 3rd ed.* http://www.who.int/water_sanitation_health/dwq/gdwq3rev/en/ Accessed January 2009

WRAP (2008a) *Battery facts and figures.* www.wrap.org.uk/local_authorities/batteries/battery_recycling_information/battery_facts_.html. Accessed July 2008

WRAP (2008b) *Q&A Processing Waste Batteries*. http://www.wrap.org.uk/local_authorities/batteries/battery_recycling_information/qa_processing.html Accessed July 2008

WRAP (2008c) *About the batteries programme*. www.wrap.org.uk/local_authorities/batteries/about_the_programme/index.html. Accessed July 2008

WRAP (2008d) *WRAP Business Plan 2008-2011: A lighter carbon footprint – the next steps to resource efficiency: a summary*. http://www.wrap.org.uk/downloads/SummaryPlan2008_11.7fa6de1a.pdf. Accessed July 2008