Socio-Economic Impacts of the Identification of Priority Hazardous Substances under the Water Framework Directive

Final Report

prepared for

European Commission
Directorate-General Environment

RPA

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by

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EXECUTIVE SUMMARY

Following recent adoption of the Water Framework Directive (WFD), the European Commission is required to identify, from a list of 32 priority substances (PS), the priority hazardous substances (PHS) that are of particular concern for the aquatic environment. Consideration of the socio-economic implications is part of the proposed procedure for the identification of PHSs.

The objective of this study is to assess the socio-economic costs, on a mainly qualitative basis, of the possible identification of substances as PHSs. It is a short study based mainly upon existing literature. A more comprehensive assessment of the impacts will be carried out at a later stage.

Costs have been assessed taking into account the effects of existing legislation and conventions relating to the PS and have been considered in the context of the maximum 20 year time period allowed for cessation of discharges, emissions and losses of PHSs. For the purposes of this study, such cessation has been taken to imply a phase-out of production and use of substances. Consideration has been given to the suitability of substitutes for the PS and the distributional and employment effects of a phase-out.

Whilst efforts have been made to ensure that the most relevant information has been obtained, given the short timeframe for the project, its wide scope (32 substances or groups of substances) and its literature-based nature, it is inevitable that there will be cost information which has not been taken into account. Thus, the discussion represents the best information available to the consultants at the time of writing, rather than the best information available per se.

It is evident that there are potentially vast implications associated with the phasing-out of certain substances, whilst for others there may be relatively few costs. This is especially true in cases where other legislation or conventions require a phase-out (making the WFD cost neutral). Furthermore, the costs for some substances could be reduced significantly over the 20 year timeframe.

A key finding is that the costs of a phase-out would vary according to the specific uses of a substance. There is thus an argument for restrictions under the WFD to be considered in terms of uses rather than the substances themselves. This argument will be greater still when the benefits of a phase-out are also considered.

There are several cases where cost implications would be greatly increased if unintentional uses and sources of PHS are targeted under the WFD. For several substances, there is a distinct lack of information on the suitability of substitutes. Additionally, several substances are considered to be ‘critical’ in terms of their safety, health or environmental benefits in certain areas of use. In the context of any phase-out of a PHS, the implications for such applications should be given careful consideration.

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1. BACKGROUND TO THE STUDY

The Water Framework Directive (WFD) was adopted by the European Parliament and the Council in September 2000[1]. Article 16 contains a legal framework and methodological basis for the prioritisation of substances. According to the WFD, the Commission 'shall submit a proposal setting out a list of priority substances selected amongst those which present a significant risk to or via the aquatic environment'. Following expert discussions, the Commission has proposed[2] a list of 32 substances based on a 'combined monitoring-based and modelling-based priority setting' (COMMPS) procedure, developed in conjunction with a consultant.

The proposed substances should be subject to emission controls and quality standards at the Community level in order to achieve a 'progressive reduction of discharges, emissions and losses'.

Within the list of priority substances (PS), the Commission shall identify the priority hazardous substances (PHS) which are of particular concern for the freshwater, coastal and marine environment. These substances will be subject to 'the cessation or phasing out of discharges, emissions and losses ... including any appropriate timetable for doing so ... [which] ... shall not exceed 20 years'.

The Commission (CEC, 2000e) has proposed a procedure for the identification of PHS which employs various checks used to specify the level of concern for the substances. Included are checks for available hazard assessments, classification as dangerous for the environment, international agreements on phase-outs of persistent organic pollutants, risk assessments under existing Community legislation and regulation under Directive 76/464/EEC (the previous means of eliminating or reducing pollution by dangerous substances).

Furthermore, there are additional checks that include consideration of the quantities of the substances produced and used and the socio-economic impacts of the identification of a substance for inclusion as a PHS.

This report presents the results of a study conducted by Risk & Policy Analysts Limited (RPA) for the Environment Directorate of the European Commission. The objective of the study is to assess the socio-economic costs of the identification of substances for inclusion as priority hazardous substances. Cost impacts are mainly evaluated on a qualitative basis.

A more comprehensive assessment of the impacts will be carried out at a later stage in accordance with Article 16 (6) and 16 (8) of the WFD. All proposals for emission controls shall 'identify the appropriate cost-effective and proportionate level and combination of product and process controls for both point and diffuse sources'.

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1 (2000/60/EC).

2 COM(2000) 47 final. OJ C 177E, 27.06.2000, p. 74.

2. APPROACH TO THE STUDY

2.1 Introduction

The Organisation for Economic Cooperation and Development (OECD, 2000) has published a framework for integrating the socio-economic impacts of possible risk reduction measures into the decision-making process for chemical risk management. In general, the aim of SEA in chemical risk management should be:

> "to strike a balance between the costs involved in reducing risks, the known benefits of the chemical in the use(s) of concern, and the benefits stemming from risk reduction" (OECD, 2000).

The OECD framework may provide an useful input in the development of economic appraisal tools which are in line with the provisions of the WFD. Detailed analyses of the cost-effectiveness and proportionate level and combination of measures to be proposed under the WFD will be carried out at a later stage (see above).

The aim of the current study is to evaluate the socio-economic costs of phasing out the priority substances under the WFD (through their identification as PHSs). Due to the short timeframe for completion of this study, information used in appraisal of the socio-economic costs has been based mainly upon existing literature sources. Additionally, information provided to the Commission by industry, Member States and other groups[3] has also been used in the appraisal of each substance.

The following key issues have been considered for the purpose of the current study:

- setting the baseline for the analysis;
- specification of the time horizon;
- predictions of the costs of risk management;
- the incorporation of distributional and employment effects;
- the assessment of substitutes; and
- management and communication of uncertainty.

Consideration has also been given to unintentional uses and sources that are applicable to several of the PSs.

2.2 Specification of the Baseline for the Analysis

The socio-economic costs are assessed from the point of view of the additional costs introduced by the WFD. The baseline refers to the present situation and anticipated outcome without the WFD. It thus considers existing legislation and conventions that have already set regulations, such as emission control/quality standards for the priority substances and also includes the likely impacts of restrictions on the marketing and use of substances in certain applications.

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3 Following Advisory Expert Meetings held on 25 and 26 September 2000.

2.3 Substitutes

The availability of suitable substitutes for chemicals (or processes/techniques) is a key consideration in the assessment of the socio-economic costs of phasing out PHSs. Some key considerations that should be taken into account when considering substitutes are:

- the market situations of possible substitutes;
- the nature of any new risks posed by the substitutes;
- the efficacy of the substitutes for all areas of use;
- any requirements introduced for new technology, equipment or processes;
- the associated costs;
- any loss of production facilities or other specialised capital and technology;
- the level of research and development necessary and associated expenditure;
- requirements for retraining of personnel on use of the substitutes;
- whether consumer satisfaction will be maintained; and
- whether some products will disappear due to a lack of substitutes (CEC, 1997).

In undertaking this short study, it has not been possible to consider all potential substitutes for all uses of all chemicals. Rather, information on the potential substitutes has been included where identified in the literature review. This information should not be seen as comprehensive.

2.4 Distributional and Employment Effects

In some cases, the identification of a substance as a PHS could in practice lead to only minor socio-economic costs. This situation could be envisaged where there is a readily available and efficacious substitute, which could be incorporated relatively easily by users within the required timeframes, and for which no shift in economic activity to outside the EU would occur (such as where a company that produces a PHS also produces the most suitable substitute).

However, there exists the potential for a shift in economic activity to outside the EU in some cases, particularly in the absence of effective substitutes. For example, where a substance is produced in the EU and exported in significant amounts, identification as a PHS (and hence a ban) would generally lead to the overseas markets being met by production sources that are also overseas. There could thus be significant regional employment effects, especially in the short term. However, in the long term, the socio-economic costs are harder to predict since phasing out a substance within the EU could initiate the development of substitutes (and thus offset some, or all, of the short-term costs).

There are also situations where a phase-out of a substance could lead to, for example, impacts upon income distribution or upon particular groups in society. It could affect particular types of company size (e.g. small and medium sized enterprises) or could create barriers to entry to a particular market.

Although such effects are difficult to predict, they have been considered in the assessment for the individual substances but only where the available information is available or it is immediately evident that there is a possibility of such effects occurring because terms of the characteristics of the production and market profile of a substance.

2.5 Timeframes Considered

A decision to identify a substance as a PHS implies a long term objective. Article 16(6) of the WFD indicates that the appropriate timetable for cessation or phasing out of discharges, emissions and losses shall not exceed 20 years.

In some cases, there would be very significant socio-economic costs associated with an immediate cessation of discharges, emissions and losses. However, for other substances, it is likely that they will cease to be essential for a particular use within that 20 year timetable (and thus the costs would be reduced), for example, where substitutes can be developed within the normal reformulation activities of products. However, there are also cases where substances will almost certainly continue to be essential for certain uses or where there are products in use with a remaining lifetime of over 20 years. Where possible, situations such as these have been identified within the consideration of individual substances in Annex A.

2.6 Intentional versus Unintentional Uses and Sources

For many of the substances, discharges, emissions or losses may result not only from intentional use but also from unintentional use. For example, a chemical may be produced in small quantities as an unwanted by-product in the manufacture of another chemical and/or an impurity in the finished product. It may then also be present in the final product and, therefore, be released to the environment at several stages.

In the context of the current study, the implications of a total cessation of losses of a PS to the environment could impact a process and product in which the substance is present unintentionally. Thus, it could be required under the WFD that the substance no longer be formed in the manufacturing process (which may be impossible in some cases), or that the entire process and product be prohibited. Such a situation could have significant cost implications.

Thus, for the purposes of this study, differentiation has been made between intentional and unintentional uses and sources.

2.7 Classification of the Costs

Four primary classifications have been used to indicate the likely cost implications (and not including the benefits) of identification of a substance as a PHS. These are as follows:

- costs are considered to be *negligible* in cases where existing (or probable) legislation would lead to a phase-out in any case;

- *moderate* costs have been considered to arise in situations where there would be cost implications which may lead to, for example, losses in operating profits or small but uncertain shifts in employment from the EU, or where the costs of the markets affected are of the order of around 10 mEUR at maximum;

- *extensive* costs have been considered to occur where markets affected are large, where there are expected to be significant shifts in activity from the EU, or where there are applications that will continue to be important in over 20 years time; and

- where there is a significant lack of information on costs, quantities and values used, any critical applications, etc., the implications have been considered to be *unpredictable*.

2.8 The Current Study

In accordance with the task brief for the study, work has focused on the following:

- a review of literature on the economics/cost assessment of controlling emissions of, or phasing out substances (including substances regulated at the national or international levels as well as at the EU level);

- definition of the ‘regulatory profile’ for the substances to include existing legislation and conventions applying to the substances and related emission and quality standards;

- definition of the ‘production profile’ for the substances to include the number of companies producing the substance, year of launching of the product, total volume produced for the last several years and turnover linked to the substance (including as a percentage of total company turnover); and

- definition of the ‘market profile’ to include the quantities used in each of the main sectors, the availability of substitutes for those sectors and the main advantages and disadvantages as compared to the substitutes (including cost elements).

In order to effectively summarise the information analysed, some of the key aspects have been tabulated as illustrated in Table 2.1. Since some of the information gained is of a qualitative nature (in line with the objectives of the study) or is subject to some uncertainty, this table includes some categorisations that give only indications of the likely magnitude of costs. Reference should also be made to the main text for each substance which, where available, contains more details on, for example, the values or costs associated with use by particular sectors or in particular applications. Annex A provides details of the findings of the study to date in the table format described above.

Table 2.1: Format for Summarisation of Data on Each Substance

Regulatory Profile	
Status of regulation	Regulation on EU, national and international levels
Production Profile	
Quantities	Quantity produced in the EU and past/future changes
Affected companies	Manufacturers (<10, <50, >50) Formulators (<10, <50, >50) Users (<50, <250, <1000, >1000) Levels of employment and size distribution of companies (e.g. many SMEs) including distributional effects relating to regulatory profile
Value of products	Specific values to companies (turnover) Values compared to total turnover
Market Profile	
Nature of use and associated quantities	Quantities used in specific applications and past/future changes. Nature of use (as final substance, part of preparation, treatment, chemical intermediate, contaminant, naturally occurring).
Employment	Yes/No for shift in activity to outside EU. Distributional effects relating to regulatory profile
Substitutes & substitution	Large/Moderate/Marginal per unit costs and time dependency Good/Moderate/Poor efficacy
Consumers	Yes/No to increases in costs
Use value of products	Any potentially health/safety/environment critical applications Time dependent importance of products
Uncertainty	
Uncertainty	Areas where information is particularly lacking

3. ASSUMPTIONS

Where the cost implications for individual substances have been considered (Annex A), these have been related to the assumption that emissions of PHSs would need to be reduced to zero under the requirements of the WFD. For the purposes of this study, this term has been taken to mean an *absolute zero emission*. This obviously has very significant implications in that it implies that even substances used exclusively within enclosed processes could be subject to a phase-out since some emission - no matter how small - will inevitably occur. This assumption has been used as a 'worst case' assumption and, therefore, has greater socio-economic implications than a requirement for emissions *close to zero*. If this latter interpretation is used, the costs may be significantly reduced (e.g. for industries that have already reduced concentrations of substances as unwanted by-products to levels approaching zero).

An important factor to note is that, even if the interpretation is that controlling emissions to zero effectively means 'close to zero', this will not be possible for situations where the substances are present in finished products. This is especially true for pesticides, which are deliberately introduced into the environment. However, it is also true for a majority of the other substances since there will inevitably be a certain level of emission/loss of a substance where it is not completely enclosed. Thus, even close to zero emissions could effectively constitute a phase-out for all substances that are not used exclusively as intermediates or process agents.

4. UNCERTAINTIES

Information used in the preparation of this report includes that which has been provided to the Commission from industry and other organisations, information already available through previous studies conducted by RPA, literature searches (including internet searches) and some information provided by governmental bodies (e.g. rapporteurs for risk assessments under the Existing Substances Regulation).

Whilst efforts have been made to ensure that the most relevant information has been obtained, given the short timeframe for the project, its wide scope (32 substances, or groups of substances) and its literature-based nature, it is inevitable that there will be cost information which has not been taken into account in the discussion. Thus, the discussion represents the best information available to the consultants at the time of writing, rather than the best information available *per se*.

More data and information are available in those cases where risk assessments have been completed and risk reduction strategies developed than where less detailed assessments have been undertaken. Further, there are certain substances where relatively little information has been identified for the purposes of this study. Thus, the level of detail of the assessment of individual substances (Annex A) varies considerably.

Furthermore, there has tended to be a greater lack of data on production and use volumes for the pesticides than for most other substances. Such information is generally only available at the EU level directly from industry; industry information has not been available for all substances.

5. SUMMARY OF FINDINGS

5.1 Overall Magnitude of Costs

Through the assessment of individual substances (at Annex A), it is evident that in many cases there are potentially vast costs associated with the phasing-out of substances. Some of these substances are integral parts of industries having turnovers of billions of Euros and employing tens of thousands of people. For example, 1,2-dichloroethane is required to produce vinyl chloride which in turn is used to produce PVC. The European PVC industry comprises more than 21,000 companies, employs over 530,000 people and has an annual turnover of more than 72 billion Euros.

At the other end of the scale, there are certain substances that are used in only very minor applications and a phase-out would tend to introduce relatively few costs upon the EU. For example, hexachlorobenzene is no longer directly produced or used in the EU and thus a phase-out of *intentional* use would have negligible effects (but see also Section 5.6).

5.2 Other Relevant Legislation and Conventions

For a number of the PSs, there are existing (or proposed) measures that will eliminate use, at least for certain sectors of use. Such measures include restrictions on the marketing and use of substances introduced at the EU level (through Directive 76/769/EEC) or conventions and agreements at the international level.

For example, the use of tributyltin in marine antifouling systems will be phased-out by 2008 under a Resolution of the International Maritime Organisation. Thus, in the context of the 20 year timetable for the introduction of measures under the WFD, there would be no additional costs imposed by the WFD (see also Section 5.3).

Similarly, the marketing and use of short chain chlorinated paraffins (SCCPs) for use in metalworking and leather processing is expected to be prohibited in the near future at the European level due to the associated environmental risks identified under Regulation EEC No. 793/93 (the Existing Substances Regulation). However, other uses are not expected to be prohibited since no unacceptable risks were identified, and thus there would indeed be additional costs associated with a phase-out under the WFD.

Assessments conducted under other legislation also have implications for the availability of data on substances and the specific uses of those substances. For example, since no unacceptable risks were identified for the other uses of SCCPs under the Existing Substances Regulation, there was less need for the examination of the advantages and drawbacks of introducing marketing and use restrictions. Thus the level of information available is dependent not only upon the *substance* being considered but also upon the individual *uses* of a substance.

5.3 Time Dependence of Costs

As mentioned previously, the timetable for cessation or phasing-out of discharges, emissions and losses of PHSs shall not exceed 20 years. For some of the substances, the timeframe considered has a significant bearing upon the costs imposed by a phase-out.

For example, it is likely that several of the plant protection products would not continue to be used in 20 years time, due to declining or already low levels of use. There could thus be negligible costs in the long-term whereas costs could be extensive in the short term. This also ties in with Section 5.2 where a longer period of time for a phase-out will allow other legislation to take effect, reducing the *additional* costs associated with the introduction of a phase-out under the WFD.

However, there are many substances that are likely to continue to be important long beyond the 20 year timeframe for a phase-out. For example, the largest use for nickel is in stainless steel which permeates hundreds of thousands of products. Many of these products will continue to be important for longer than 20 years. Similarly, benzene is used in the manufacture of thousands of products where there would be extensive costs associated with a phase-out, irrespective of the timeframe considered.

5.4 Differences Amongst Individual Uses of Substances

For many of the substances considered, there are significant differences in the costs of a phase-out depending upon the way in which a substance is used. Such differences are caused through factors such as the availability and costs of substitute chemicals.

For example, in the case of nonylphenols, the estimated costs for phasing out the 18 kt used in textile and leather processing (in 1995) were estimated as 81 mEUR, while the costs for the 12 kt used in emulsion polymerisation were estimated as 557 mEUR. There is thus a factor of 10 difference in the costs imposed per tonne of nonylphenol removed.

It should also be noted (though not an aspect of this study) that in addition to the variations in costs between uses of substances, there will also be differences in the benefits of a phase-out for the different uses due to the different level of risk posed by use in different applications. There is an argument for restrictions under the WFD to be considered in terms of the *uses* of substances rather than simply the substance itself, purely in terms of the costs imposed. There is a greater argument still for such an approach when the benefits of a phase-out are considered.

5.5 Intentional versus Unintentional Uses and Sources

As discussed in Section 2.6, there are various unintentional uses and sources of several of the substances considered which would make a phase-out very costly or essentially impossible.

These include, for example, cases where a substance is not produced directly but is (unavoidably) produced as a by-product of the manufacture of other substances - and is also often present in the finished product. This is true in the case of, for example, hexachlorobenzene and hexachlorobutadiene. Neither of these substances are produced intentionally in the EU but are formed in the production of various organochlorine substances, such as PVC (the market for which was discussed above). To phase-out discharges, emissions and losses of these substances could imply that those industries would also be phased-out, having huge cost implications.

There are also cases where emissions of substances occur via other unintentional sources. For example, aromatic hydrocarbons (including PAHs, benzene, naphthalene and anthracene) are produced through combustion processes. Thus, to totally phase-out emissions of these substances would prevent for example, use of the internal combustion engine and electricity generation through fossil fuel combustion. Moreover, such a phase-out would be impossible since combustion processes also occur naturally[4]. It should also

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[4] Though of course any measures adopted under the WFD could not attempt to address the natural sources of substances.

be noted that such sources may be the greatest contributor to levels of these substances in the environment (as is the case, for example, with naphthalene).

Furthermore, all of the metals (nickel, lead, cadmium and mercury) occur naturally and, in addition to there being natural sources, they are present to some degree in many products or resources as an impurity (such as in rocks and in other metals). Some of the other substances, such as chloroform, also occur naturally and thus a phase-out of all emissions (including those from natural sources) would not be technically feasible. Whilst natural sources are an important consideration. provisions under the WFD are only related to anthropogenic emissions.

5.6 Substitutes

For many of the substances considered, there is a lack of information on the availability of suitable substitutes (and in several cases there are no substitutes). This is the case for several plant protection products where various potential substitutes have been suggested but it has not been possible to adequately assess the implications in terms of costs, efficacy and environmental and health effects. There are a variety of factors that need to be considered, such as the application rates required, local climatic conditions, the crop type (for agricultural PPPs), as well as factors such as the potential for pest resistance to develop where fewer PPPs can be applied.

There are also some situations where the most suitable substitutes may be other potential PHSs. For example, lead stabilisers are the most technically suitable alternatives for cadmium stabilisers in some PVC products. The same is true for nonylphenols and octylphenols (though only for a few uses). Similarly, some of the plant protection products are potential substitutes for others on the list (such as atrazine and simazine). In such cases, for the future comprehensive assessment, evaluation should include the *overall* costs.

5.7 Critical Applications

For several of the PSs, there are certain applications that have been considered to be ‘critical’ in terms of their safety, health or environmental benefits and for which there are no readily available substitutes. In the context of any phase-out of a PHS, the implications for such applications should be given careful consideration. Examples of these include:

- use of nonylphenols in spermicides;
- use of benzene, dichloromethane, naphthalene and trichlorobenzene in pharmaceuticals; and
- many uses of metals, such as nickel in stainless steel.

For some of these applications, substitutes may be developed over the 20 year timeframe. However, for others, it is probable that suitable substitutes could not be found within that time.

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ANNEX A

ASSESSMENT OF INDIVIDUAL SUBSTANCES

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A1. ALACHLOR

A1.1 Regulatory Profile

Assessment under 91/414/EEC has not yet been completed. Alachlor is prohibited for use in several Member States. For example, approvals expired in 1992 in the UK (Whitehead, 1999).

A1.2 Production Profile

Only one supplier of alachlor (based in Germany) is listed in the Chemicals and Companies database (RSC, 1998). The Chemical Directory (CIA, 2000) lists two producers within the EU and one additional supplier.

A1.3 Market Profile

Alachlor would appear to be authorised for use in five Member States at the present time: France, Spain, Portugal, Italy and Greece (CEC, 2000d). Based upon this use pattern, it would appear to be most suited to warmer climates. Alachlor is used as a herbicide on crops such as corn, cabbage and cotton.

No information has been found on the quantities used or produced in the EU, nor the associated values. However, an estimated 6,000 to 7,000 tpa are used in the United States.

Table A1.1: Summary Information for Alachlor	
Regulatory Profile	
Status of regulation	Assessment under 91/414/EEC not yet complete
Production Profile	
Quantities	Unknown
Affected companies	Manufacturers <10 Formulators <10 Users - Unknown Use by farmers will likely include some SMEs
Value of products	Unknown
Market Profile	
Nature of use and associated quantities	Used as herbicide on certain crops. Quantities unknown
Employment	Unknown
Substitutes & substitution	Certainly substitutes in N Europe (since no longer used). May be more problematic in Southern Member States
Consumers	Unknown
Use value of products	Implications for production of food Probably relatively likely to be able to develop substitutes within 20 years (as only used in five Member States)

Table A1.2: Assessment of Uncertainty and Socio-Economic Costs for Alachlor	
Uncertainty	Quantities used, substitutes
Qualitative assessment of socio-economic costs	Unpredictable

A2. ANTHRACENE

A2.1 Regulatory Profile

Anthracene is on the second priority list of substances under Regulation EEC No. 793/93 on the evaluation and control of the risks of existing substances. Under that Regulation, Greece is the rapporteur for risk assessment and management. This risk assessment has not yet been completed but is expected in autumn 2000 (ECB, 2000a).

Anthracene is also on the 'candidate list' of substances under Directive 76/464/EEC and, as such, Community-wide emission limits or quality standards have not yet been developed.

Since anthracene is a PAH, it is also covered under Annex 2 to the OSPAR Strategy with regard to hazardous substances (OSPAR, 2000).

A2.2 Production Profile

Anthracene is produced as a by-product of coal tar distillation, although it may also be produced from petroleum. In terms of the former, there are several EU companies involved in the distillation of coal tar, most of which are expected to produce anthracene.

Figure A2.1 illustrates the production volume of anthracene in the EU since 1987. It is evident that production has fallen considerably in recent years.

Figure A2.1: EU Production of Anthracene (based on ECB, 2000c)

For the producers, anthracene will also be present in many of their other products (e.g. creosote). A zero-emissions policy for anthracene could, therefore, mean the phase-out of all other products and the whole of many of those companies' (coal tar distillers) turnover.

In addition to pure anthracene, there are various other anthracene compounds produced in the EU. These are listed in Table A2.1, along with the stated production volume in the most recent version of the IUCLID Database.

Table A2.1: Other Anthracene-Containing Substances and IUCLID Production Volumes		
Substance	**Uses**	**Production**
Anthracene Oil	Chemical intermediate, wood preservation, solvent	> 1,000,000 t
Anthracene oil, anthracene paste	Chemical intermediate	1-500,000 t
Anthracene oil, anthracene low	Chemical intermediate, solvent	1-500,000 t
Anthracene oil, anthracene paste, anthracene fraction	-	-
Anthracene oil, anthracene paste, carbazole fraction	-	-
Anthracene oil, anthracene paste, distn. lights	-	-
Source: ECB (2000b)		

These are all potential sources of anthracene in the environment. However, anthracene is also produced unintentionally and also naturally as a product of combustion processes. For example, the IUCLID Database gives the following possible sources: "automobile traffic, residential heating, cigarette smoke, open burning, abrasion of asphalt additionally to industrial sources as hard coal refineries, coking plants, aluminium industry, oil and coal power plants" (ECB, 2000b). These may actually be the greatest source of anthracene in the environment, as is the case for naphthalene (as described by Environment Agency (1999a)).

If only the intentional production and use of anthracene is phased out, there will be extensive economic costs due to the large quantities of the other products which contain it (though they would be moderate for anthracene itself). If all of the unintentional sources are included as sources for which there should be cessation of emissions, discharges and losses, the economic implications would be greater still.

A2.3 Market Profile

Overall, there are a great number of uses for anthracene and for associated compounds. These include:

- chemical synthesis;
- creosote and other wood preservatives;
- tar paints, waterproof membranes and related products;
- other industrial products; and
- specialised scientific uses (ECB, 2000c).

For some time, anthracene was used in the production of anthraquinone which is used to manufacture many dye products. However, EU production of anthraquinone ceased in 1998. Furthermore, anthracene oil and coal tar (both containing anthracene) may no longer be used in cosmetics such as soaps, lotions, oils, shampoos and gels, having been prohibited by Directive 76/769/EEC and 97/45/EEC respectively.

The main intentional use is, therefore, likely to be in chemical synthesis. There could be extensive economic effects associated with a phase out of this use since the final products may have large associated values. For other uses, such as creosote and tar paints (see also Section A27), anthracene is often a significant component of these multi-component mixtures. Costs for removing anthracene from these mixtures would be extensive[1].

Table A2.2: Summary Information for Anthracene	
Regulatory Profile	
Status of regulation	Assessment under Regulation EEC No 793/93 incomplete
Production Profile	
Quantities	550 tpa intentionally (decreasing)
Affected companies	Manufacturers: <50 Formulators: <50 (estimate) Users: <1000 Users are likely to include SMEs. Far greater numbers if include components of other products, unintentional uses, etc.
Value of products	Specific values to companies: probably several hundred thousand Euro directly Values compared to total turnover: probably few % directly but often all turnover for other products in which it is contained
Market Profile	
Nature of use and associated quantities	Chemical synthesis and scientific uses directly; indirectly includes creosote and other wood preservatives; tar paints, waterproof membranes and related products; and other industrial products. Also product of almost all combustion processes
Employment	Shift in activity to outside EU likely (very large if include wider ‘uses’)
Substitutes & substitution	Probably none for some uses as chemical intermediate. Others, e.g. wood preservatives may be more expensive and less efficacious
Consumers	Likely increases in costs for various products
Use value of products	Some health/safety/environment critical applications if include wider uses Continued dependence for many applications

1 E.g. the creosote industry has devoted considerable expenditure to reduction of benzo[a]pyrene from their products and to make even greater reductions could mean some companies going out of business. For example, individual companies experienced one-off costs of up to 2 mEUR plus losses of sales of up to 1.6 mEUR per annum (see e.g. RPA, 2000c). The situation would likely be similar for anthracene.

Table A2.3: Assessment of Uncertainty and Socio-Economic Costs for Anthracene	
Uncertainty	-
Qualitative assessment of socio-economic costs	Moderate/extensive for intentional use. Extensive for other uses and emissions (unintentional uses)

A3. ATRAZINE

A3.1 Regulatory Profile

Assessment under Directive 91/414/EEC is not yet complete but is reported to be well advanced. It is on the 'candidate list' under Directive 76/464/EEC and thus harmonised emission limits and quality standards have not yet been developed.

A3.2 Production Profile

There is one, relatively small producer of atrazine in the EU. The remaining amounts are imported, particularly from the United States. It is estimated that around 700 tpa are produced in the EU (based upon information in ECPA, 2000b).

There are 11 companies reported to be producing/supplying atrazine in the Chemicals and Companies Database (RSC, 1998).

A3.3 Market Profile

Sales of atrazine in the EU are around 2,000 tpa based upon sales projections for 2001 (ECPA, 2000b).

Atrazine is used on a variety of crops as a herbicide. It is reported to be authorised for use in all Member States except Finland, Sweden, Denmark, Germany and Austria (CEC, 2000d). Its use within other Member States is also restricted (Whitehead, 1999).

It has selective herbicidal for the control of broadleaf and grassy weeds on cropped land but also acts as a non-selective herbicide on non-cropped land.

No information has been found on the costs of banning atrazine in the EU context. However, estimates for the USA have suggested that a ban could cost producers and consumers US$517 (short term) to US$665 million (long term) for their annual use of 80 to 90 million pounds per annum. This would equate to 33 mEUR for the use in the EU (if the cost per tonne of atrazine were the same). The US cost estimates were based upon an economic model which predicted effects such as a shift to more costly weed control strategies and decreased corn yields (Ribaudo and Bouzaher, 1994). It is unknown how applicable such estimates would be for the EU and the estimation of 33 mEUR above should not be read as a suggested estimate for the costs for the EU.

Possible alternatives to atrazine are reported to include cyanazine, simazine and bromoxynil (DETR, 1999b). Their efficacy and economic implications have not been examined. It should be noted that simazine is also a PS and thus the overall implications could be greater if both atrazine and simazine were to become PHSs.

Table A3.1: Summary Information for Atrazine	
Regulatory Profile	
Status of regulation	Assessment under 91/414/EEC not yet complete
Production Profile	
Quantities	700 tpa
Affected companies	Manufacturers <10 Formulators <50 Users <1000? Users will include SMEs
Value of products	Relatively low value to producer but possibly more to suppliers
Market Profile	
Nature of use and associated quantities	Sales of 2,000 tpa. Use as herbicide on cropped and non-cropped land
Employment	Unknown whether employment will shift from EU
Substitutes & substitution	Some available but efficacy and cost implications unknown
Consumers	Unknown
Use value of products	Implications for production of food

Table A3.2: Assessment of Uncertainty and Socio-Economic Costs for Atrazine	
Uncertainty	Values of products, substitutes
Qualitative assessment of socio-economic costs	Unpredictable (possibly moderate over 20 year timetable)

A4. BENZENE

A4.1 Regulatory Profile

A risk assessment under Regulation EEC No. 793/93 has been drafted by the German competent authority (BAuA, 2000). Risk reduction work has not yet been undertaken since no final conclusions have been reached in the report.

Benzene is a VOC designated for emission reduction under Directive 1999/13/EC. Limit values for drinking water have been introduced under Directive 98/83/EC.

Maximum concentration limits have been introduced under an amendment to Directive 76/769/EEC for toys (Directive 82/806/EEC) and substances and preparations placed on the market, except in motor fuels, where used in industrial processes and in certain types of waste (Directive 89/677/EEC).

A4.2 Production Profile

Pure benzene can be isolated from coal tar oil and by refining crude oil. Over half of the benzene demand is covered by means of extractive distillation of pyrolysis gasoline. The total production volume in the EU has been estimated as 7,084,000 tpa, with production sites in at least 11 Member States. The risk assessment utilises data from 48 companies. Imports were reported to be 576,128 tpa and exports 128,902 tpa in 1994 (BAuA, 2000).

A4.3 Market Profile

Imports and exports of benzene are relatively small as compared to production. Thus, EU consumption is somewhat over 7 million tpa.

The main applications for pure benzene are production of three derivatives - ethylbenzene, cumene and cyclohexane (accounting for around 85% of consumption in 1994). These are in turn used in the manufacture of various other products. Benzene forms the basis for a great variety of aromatic intermediates and for the group of cycloaliphatic compounds. It is used as the basis for the manufacture of plastics, synthetic rubber, dyestuffs, resins, raw materials for detergents, and plant protection agents.

Table A4.1 describes the EU use pattern for benzene, as detailed in the risk assessment.

Benzene is present in hundreds of consumer products, as identified by the Danish and Swedish Product Registers: 805 and 83 products respectively (BAuA, 2000).

It should be noted that there exist numerous unintentional sources of benzene emissions to the environment, including its unintentional presence in various products and also natural emissions sources (e.g. volcanoes and forest fires).

Table A4.1: EU Uses of Pure Benzene		
Use	**Description**	**Use (%)**
Ethyl benzene	Processed to poly(styrene) used in automobile, building and packaging industries	52%
Cumene	Oxidised to phenol (used in synthetic-fibres and synthetic-resins industry and is used in the manufacture of veneer glues, car brake linings and resins for the paints industry)	20%
Cyclohexane	Includes nylon production for textiles, tyres, packing material etc & important thermoplastics	13%
Nitrobenzene	Exclusively from benzene for the manufacture of aniline dyes and polyurethane foams	9%
Alkylbenzene(s)	Manufacture of surfactants	3%
Maleic Anhydride and others	For unsaturated polyester resins and some plant protection agents and in lubricating oil additives and antioxidants for oils and greases	2%
Chlorobenzene	PPPs, pharmaceuticals, dyestuffs, rubber auxiliaries, textile auxiliaries, disinfectants, air deodorisers, chemical industry (solvents, oils, greases, resins, rubber, ethylcellulose, etc.)	1%
Laboratory reagent and solvent		Small and declining
Source: BAuA (2000)		

There is no doubt that the economic implications of preventing emissions of benzene would be extensive. Notwithstanding the natural emissions and those through combustion sources, use of industrially produced benzene permeates industries for which there would be highly significant implications and many for which there are no known substitutes.

Table A4.2: Summary Information for Benzene	
Regulatory Profile	
Status of regulation	Risk assessment in progress. Limit values in water. Concentration limits in products
Production Profile	
Quantities	Over 7 million tpa
Affected companies	Manufacturers <50 Formulators >50 Users >1000 Manufacturers mainly large companies. Users include companies of all sizes
Value of products	Production worth hundreds or thousands of mEUR Will be large proportion of manufacturers' turnover
Market Profile	
Nature of use and associated quantities	Many applications (see table)
Employment	Shift in activity from EU for many applications is probable
Substitutes & substitution	No substitutes for many applications
Consumers	Definite increases in costs and loss of many products
Use value of products	Many health, safety and environment critical applications (and certain to continue to be in the future)

Table A4.3: Assessment of Uncertainty and Socio-Economic Costs for Benzene	
Uncertainty	Information not collected on values of end-products
Qualitative assessment of socio-economic costs	Extensive

A5. POLYBROMINATED DIPHENYL ETHERS

A5.1 Regulatory Profile

All three commercially produced products (penta-, octa- and deca-BDPE) are subject to risk assessment under Regulation EEC No. 793/93. The assessment is complete for penta-BDPE and has identified unacceptable risks from use in polyurethane foams (the only use identified in the risk assessment). The discussion herein focuses mainly on penta-BDPE for which a ban has been proposed through an amendment to Directive 76/769/EEC relating to the restrictions on the marketing and use of certain dangerous substances and preparations.

As part of the group of brominated flame retardants, PBDEs are included under Annex 2 to the OSPAR Strategy with regard to hazardous substances.

Certain brominated flame retardants (including PBDEs) are also included on exclusion lists for the EC Ecolabel. There are several other initiatives which will reduce use and emissions of PBDEs, such as the Swedish intention to phase out their use.

Under the proposed Directive on Waste Electrical and Electronic Equipment (WEEE), it is proposed that PBDEs are substituted by other substances by 2008 in electronic and electrical equipment (CEC, 2000c).

A5.2 Production Profile

Penta-BDPE is not produced in the EU. It is imported by two companies, one of which reformulates it and sells it on to both EU and non-EU markets (RPA, 2000a).

The market for penta-BDPE has been estimated to be around 4.3 million Euro per year, based upon EU use of 300 tpa and imports within products of 800 tpa. However, total use is estimated to be around 250 tpa at present (RPA, 2000a).

Octa and deca-BDPE are more widely used, with production occurring within the EU and use in a wider range of applications. Production and use values for 1999 were 450 tpa and 7,500 tpa respectively. These could be expected to have a value of around 31 mEUR (IAL Consultants, 1997) and the value of the finished products affected by any ban would be greater still.

A5.3 Market Profile

Penta-BDPE is used in polyurethane foams for upholstery products and automotive applications and also in some non-foamed polyurethane products. The European Brominated Flame Retardants Industry Panel accept that a proposal for phase-out of penta-BDPE is a necessary outcome from the ESR risk assessment (EBFRIP, 2000).

Deca-BDPE is an additive flame retardant which is mainly used in plastics and textiles. Overall uses were as follows for the early 1990s:

- 30% Polystyrene (HIPS) [moulding parts, panels, housing];
- 20% Terephthalates (PBT, PET) [moulding products, connectors, switch-gears, electrical equipment];
- 15% Polyamides (PA) [injection moulding, contactors, bobbins, electrical elements];
- 10% Styrenic rubbers (SBR) [latex, carpet backing, furniture];
- 5% Polycarbonates (PC) [moulding parts, panels, housing, computers, aircraft];
- 5% Polypropylene (PP) [injection moulding, capacitors, TV, electronics]; and
- 15% Other polymer applications and end uses, notably: Acetate copolymer (EVA) [extrusion, coating, wire, cables, electrical distribution] and unsaturated polyester resins (UPE) [moulding compounds, panels, boxes, electrical equipment] (Danish EPA, 1999).

Octa-BDPE is used in conjunction with antimony oxide, primarily in ABS polymers. The remainder (5%) is used in HIPS, polybutylene terephthalate (PBT) and polyamides. These are frequently used in housings for office equipment and business machines.

There are a range of alternative flame retardants that may be suitable for certain applications. Such alternatives include other halogenated organic compounds, magnesium hydroxide, red phosphorus, phosphate esters, melamine (and melamine derivatives), and also other techniques to improve the fire retardancy of products. However, where a substance may be replaced in one application by a certain alternative flame retardant, that same alternative may not be suitable for another application, depending upon factors such as the level of fire retardancy required by the relevant standards and the material requirements of the finished product.

In terms of reduction of emissions, it may be possible to reduce emissions during production and incorporation into products in some situations (but at unknown cost). However, it will generally not be possible to reduce or eliminate emissions from products during their use (and hence to cease or phase-out discharges, emissions and losses would imply banning the substances).

Table A5.1: Summary Information for Polybrominated Diphenyl Ethers	
Regulatory Profile	
Status of regulation	Banned proposed on Penta-BDPE at EU level. Risk assessments for octa- and deca- are ongoing
Production Profile	
Quantities	250 tpa (penta-BDPE); 450 tpa (octa-), 7,500 tpa (deca-)
Affected companies	Manufacturers <10 Formulators <10 Users <50 for penta-, perhaps <250 for deca-
Value of products	< Euro 4.3m p.a. for penta-. Perhaps Euro 30m for all Relatively small compared to total producers' turnover
Market Profile	
Nature of use and associated quantities	As flame retardants in polyurethane foams (penta-BDPE). Octa- and deca- used in various other plastics as flame retardants
Employment	No effect for penta-BDPE since measures already proposed. Likely shift to outside EU for deca- (and octa-)
Substitutes & substitution	Costs of substitutes variable Equivalent efficacy for some uses but not all
Consumers	Potential increase in costs (but no additional cost for penta-BDPE)
Use value of products	Many safety critical applications (since used as flame retardants) Over time, reliance expected to decrease but may not disappear within 20 years

Table A5.2: Assessment of Uncertainty and Socio-Economic Costs for PBDEs	
Uncertainty	Less information for octa and deca since risk assessments are not finalised (and thus no risk reduction strategies conducted)
Qualitative assessment of socio-economic costs	Negligible additional effects for penta-BDPE. Extensive values of products for octa- and deca- but potential for substitution unknown

A6. CADMIUM

A6.1 Regulatory Profile

Certain uses of cadmium are prohibited under Directive 91/338/EEC which amends Directive 76/769/EEC. This restricts the uses for which cadmium may be used as a stabiliser, a pigment and in metal plating. Exemptions are provided for various safety-critical applications.

Risk assessment under Regulation EEC No. 793/93 (with Belgium as rapporteur) is not yet complete.

Emission limits and quality standards have been developed under Directive 83/513/EEC. Limit values for drinking water (98/83/EC) and sewage sludge (86/278/EEC) have also been introduced.

Batteries containing over 0.025% of cadmium by weight are also covered by Directive 91/157/EEC on batteries and accumulators containing certain dangerous substances. The European Commission is planning to revise this Directive. It is considering prohibiting the marketing of nickel-cadmium (NiCd) batteries, where substitutes are available, possibly from 2008.

Directive 2000/53/EC on end of life vehicles restricts the content of mercury, lead, cadmium, and hexavalent chromium of materials and components in vehicles as from 2003. As regards cadmium, this applies also to use of cadmium in batteries. Annex II to the Directive contains derogations to the ban and provides for the possibility of later modification through a Committee procedure. It is stated that the Commission will assess cadmium in batteries for electric vehicles as a matter of priority.

Directive 94/62/EC on packaging and packaging waste limits the concentration of lead, mercury, cadmium and hexavalent chromium in packaging.

It is proposed that cadmium should not be used in electrical and electronic equipment after 2008 under the proposed WEEE Directive (CEC, 2000c).

Cadmium is also covered under Annex 2 to the OSPAR Strategy with regard to hazardous substances (OSPAR, 2000a).

A6.2 Production Profile

Cadmium is produced primarily as a by-product of the refining of zinc. In 1996, the reported EU production of cadmium was 5,808 tpa. Since then, several EU producers have reportedly stopped producing cadmium metal (Eurometaux, 2000).

Cadmium from recycling operations is around 337 tpa for cadmium recovered from batteries collected from the market and from industrial sources (reported to go back into NiCd batteries).

A6.3 Market Profile

Overview of Uses

Table A6.1 details the various end-uses for cadmium in the EU. 1,920 tonnes of cadmium (including 653 tonnes within products) were imported and 3,670 tonnes (including 1,470 tonnes within products) were exported in 1996 (CollectNiCad, 2000b).

Table A6.1: Applications for Cadmium in 1996

	Quantity (tpa)	Quantity (%)
NiCd batteries	1,983	72
Pigments	392	14
Stabiliser	131	5
Metal plating agent	220	8
Alloy	28	1
Total	**2,754**	**100**

Source: Eurometaux (2000)
Note: Use in metal plating may actually be lower at 106 tpa (CollectNiCad, 2000b)

Stabilisers

For the use in stabilisers, additional economic implications are likely to be negligible since this use is expected to be phased out (voluntarily) within less than a year. However, if lead were also to be identified as a PHS (see Section A19), there would be potentially very significant implications for stabilisers in PVC, since lead stabilisers have been used to replace cadmium ones in various products.

Pigments

A study by WS Atkins (1998) estimated that, for pigments, the percentage of total manufacturer turnover affected by a ban would be between 2.5% and 37%. Total loss for producers of pigments could be 20 mEUR, with 300 to 500 jobs at risk and the closure of 3 or 4 plants (although this would be compensated to some extent by sales of alternative pigments). Thus, an immediate phase-out in pigments would have significant implications. However, there is reported to be a general decline in the use of cadmium-containing pigments (CollectNiCad, 2000b) and thus the effects could be more limited within the 20 year timetable for a phase-out under the WFD.

Metal Plating

For metal plating a 1998 study (WS Atkins, 1998) concluded the following:

> "The effects of a total or partial ban would ... be:
> - very little impact, positive or negative on the plating industry;
> - negative effects on the end-user industry because of the unsuitability of alternatives (technical feasibility); but
> - a probable boost to research and development efforts to find suitable alternatives."

Use of cadmium in metal plating is reported to be stable for certain applications (CollectNiCad, 2000b) due to the current lack of technically feasible alternatives. Thus, significant effects could be expected in the short term. These will probably be less over the 20 year timetable but to an unknown extent.

Batteries

Whilst NiCd batteries have been phased out of some applications, certain battery companies are reported to be reverting to NiCd type batteries, having recognised that other chemistries have certain limitations (Anyadike, 1999). NiCd batteries are quick to charge up, have a high number of charging cycles, good load performance and are economical (Anyadike, 1999).

Although separate collection of NiCd batteries has been obligatory since 1992, just over 300 tonnes of cadmium was collected in 1999 compared to 2,200 tonnes present in NiCd batteries placed on the market, However, the recycling of NiCd batteries is likely to increase in the future (CollectNiCad, 2000a).

A reported 653 tonnes of cadmium was imported within batteries in 1996 (portable batteries only). Exports were reported to be 592 tonnes in portable batteries and 158 tonnes in industrial batteries.

The European industry is reported to be very competitive in terms of production of cadmium oxide, for which there are significant exports (CollectNiCad, 2000b). If this process were to be prohibited, there is the potential for a significant loss of activity to countries outside the EU (especially in the short term whilst there remains a global demand for NiCd batteries).

A 1997 study for the European Commission (ERM, 1997) indicated that a phase-out of NiCd batteries may be technically feasible since alternatives are available for many applications. However, in the short-term, there would be significant associated technical difficulties and negative trade impacts and a rapid phase-out was estimated to imply a possible 300 mEUR passed on each year to consumers. However, the authors stated that these costs would be significantly lower over a longer period.

Another study (Noréus, 2000), indicates that nickel metal hydride (NiMH) and lithium ion batteries are suitable replacements for NiCd cells in the vastly expanding consumer markets for products such as mobile phones and laptop computers. However, the report indicates that substitution in high power applications, such as cordless power tools[2], was only recently initiated. In 1997, the first NiMH cells adapted for high *power* applications became commercially available. This was almost seven years after the first generation of NiMH cells which were originally developed for high *capacity* applications. The capacity of those (high capacity) NiMH cells superseded that of the available NiCd cells by 80%. The capacity of a high power NiMH cell, however, will only supersede a corresponding high power NiCd cell by 30%, which makes the substitution not as attractive as for high capacity cells.

In the absence of further legislation, the market for NiCd batteries is likely to remain strong in certain applications where other chemistries cannot offer a more favourable cost/performance ratio (CollectNiCad, 2000c).

Several of the companies that produce NiCd batteries are also researching and marketing alternatives (such as NiMH) as part of normal development activity. Thus, there may not be a significant shift in activity associated with a ban (although the market has already moved significantly away from the EU). It is reported that 40,000 jobs could be affected by a ban on the use of cadmium in batteries. However, these jobs would not necessarily be lost (and the number is thought to refer to the number of people employed in the industry), since the NiCd battery producers also produce the substitutes.

In conclusion, the effects of a ban are expected to be significant in the short term but will decrease over time. Over the 20 year timetable for introducing requirements for PHS under the WFD, the socio-economic effects will be reduced significantly for many applications (and the direct effects of the WFD may be negligible if NiCd batteries are banned through other means). There may, however, be some applications in which the use of cadmium in batteries remains important.

Unintentional Sources

There are also various other (unintentional) sources which may be responsible for highly significant levels of emissions to the environment. These include content in phosphate fertilisers and emissions from natural sources, combustion processes and iron and steel processes.

Estimates of the effects of introducing a charge on cadmium in fertilisers have been developed by Oosterhuis *et al* (2000). This report concluded that an EU-wide charge would generally have the effect of an increase in the demand for low-cadmium raw material for the production of phosphate fertilisers for the EU market. The effects on the producers of fertilisers would be limited if they were given sufficient time to prepare for the charge. The effects on EU farmers would be small although the economic effects on some raw material and fertiliser producer countries outside the EU could be significant.

[2] Compared with mobile phones, which require high capacity.

Table A6.2: Summary Information for Cadmium	
Regulatory Profile	
Status of regulation	Risk assessment under 793/93. Emission limits and quality standards. Controls on other uses
Production Profile	
Quantities	5,808 tpa in 1996 (probably lower now)
Affected companies	Manufacturers: unknown Formulators: <50 Users: >1000 Many small companies in 'users'
Value of products	Unknown
Market Profile	
Nature of use and associated quantities	2,754 tpa broken down according to Table A6.1
Employment	Negligible effects for stabilisers, moderate for plating, extensive for pigments, unpredictable for batteries. However, all reduced significantly in longer term. Also large potential effects from unintentional emissions and uses
Substitutes & substitution	Cost-effective substitutes available for stabilisers, metal plating and some battery applications Metal plating substitutes less efficacious
Consumers	Probable increase in costs and/or reduced performance for some applications (e.g. metal plating)
Use value of products	Safety critical applications in pigments and plating Some uses expected to become less important but certainly not all

Table A6.3: Assessment of Uncertainty and Socio-Economic Costs for SCCPs	
Uncertainty	-
Qualitative assessment of socio-economic costs	Negligible for stabilisers. Extensive but probably decreasing for pigments, plating and batteries (costs for batteries may be reduced, depending upon future legislation). Extensive for unintentional sources

A7. SHORT CHAIN CHLORINATED PARAFFINS

A7.1 Regulatory Profile

A risk assessment for SCCPs has been completed under Regulation 793/93/EEC. This indicated unacceptable risks from use in metalworking and leather processing. Other uses (in paints, coatings, sealants and as a flame retardant in rubber, plastics and textiles) were not identified as posing unacceptable risks. There are currently proposals to prohibit use in the metalworking and leather processing sectors with a review proposed for the other sectors of use (CEC, 2000a).

The OSPAR Commission has adopted Decision 95/1 which would end essentially all use of SCCPs by 2004. This is the only one of OSPAR's priority substances for which such a Decision has been issued. SCCPs are covered under Annex 2 to the OSPAR Strategy with regard to hazardous substances (OSPAR, 2000). However, the EU is a party to Decision 95/1 and the Decision has not been accepted by the UK (though it has been accepted by 11 Member States).

A7.2 Production Profile

Total use of SCCPs was 4,075 tpa in 1998, compared to 13,208 tpa in 1994. Use is continuing to decrease for the metalworking and leather industries. The 1998 market is estimated to have a value to producers of Euro 3m per annum (Eurochlor, 2000e). There are two companies producing SCCPs in the EU: one in the UK and one in Italy.

A7.3 Market Profile

The use pattern for SCCPs in 1998 is illustrated in Table A7.1.

Table A7.1: Use Pattern for SCCPs in the EU in 1998 (tonnes)

Sector of Use	**1998**
PVC plasticisers	13
Metalworking fluids	2,018
Flame retardant in textiles and rubber	617
Waterproofing textiles	21
Paints, sealants and adhesives	713
Leather	45
Sales through distributors	648
Total	**4,075**

The current costs of a ban on use in the metalworking industry are expected to be moderate but justified on the basis of the balance of advantages and drawbacks. For the leather processing industry, effects are expected to be negligible considering the significantly reduced level of use and low costs for substitution. The WFD would not have any additional impacts in this respect beyond the proposed prohibition on use (CEC, 2000a).

Use in polysulfide sealants is currently strong in some Member States. However, this use is expected to decrease in the long term as products are replaced by polyurethanes, etc. It is not certain, however, whether this would imply discontinued use within the 20 year timetable. Certainly, there are likely to be some products still in use over longer periods, and use of SCCPs could continue for this and some of the other applications, particularly in those countries for which Decision 95/1 does not apply. However, if the Decision is implemented in those countries that have accepted the Decision, there will be negligible additional costs imposed by the WFD for those countries.

Economic and social effects of a ban have been examined for some of the uses other than metalworking and leather processing at the EU-level (ERM, 1999). This study estimates that there could be potentially greater implications for uses other than metalworking and leather finishing. For example, where used as a flame retardant in synthetic rubber and PVC, the cost of finished products could increase by 15-20%, which would disadvantage EU producers and, at least in one case, lead could to job losses (e.g. one company could lose 90 jobs, another company would close down). The study also indicates that cessation of production of cable resins for mining would occur in the event of a ban on SCCPs due to pressures of a decline in the industry. This may lead to loss of jobs and 4.5 to 7.5 mEUR loss of market share for a single company.

Finally, where used as a flame retardant, it is important to consider the need to meet fire safety standards for finished products.

Table A7.2: Summary Information for Short Chain Chlorinated Paraffins	
Regulatory Profile	
Status of regulation	Proposed EU ban for metalworking and leather sectors PARCOM Decision 95/1 for (essentially) all uses
Production Profile	
Quantities	Around 4,000 tpa and decreasing (but not for all applications)
Affected companies	Manufacturers <10 Formulators >50 Users >1000 Producers also produce longer chain chlorinated paraffin alternatives although some companies would shift to non-CP products produced by others
Value of products	3 mEUR to producers Fairly minimal compared to total turnover
Market Profile	
Nature of use and associated quantities	Metal working fluids (about 50% but decreasing), flame retardants in textile and rubbers (about 15%), plasticisers/flame retardants in paints and coating (about 10%) and sealants/adhesives (about 7%)
Employment	Shift in activity to outside EU unlikely for metalworking and leather but likely for other uses. WFD will have no additional effect for metalworking and leather but will for other uses (particularly those not committed to Decision 95/1)
Substitutes & substitution	Substitutes available for most applications. Low cost for leather, moderate for metalworking, moderate to extensive for other uses Some alternatives have poor efficacy
Consumers	Small increase in costs for metalworked products and very small for leather. Greater costs for uses such as plasticiser and flame retardant
Use value of products	Safety critical where used as flame retardant Development of substitutes possible for most applications within 20 years

Table A7.3: Assessment of Uncertainty and Socio-Economic Costs for SCCPs	
Uncertainty	More information available for metalworking and leather than other uses since investigated further due to consideration of marketing and use restrictions following identification of unacceptable risks
Qualitative assessment of socio-economic costs	Negligible additional effects for metalworking and leather over 20 years. Moderate/extensive for other uses

A8. CHLORFENVINPHOS

A8.1 Regulatory Profile

Assessment of chlorfenvinphos under Directive 91/414/EEC is not yet complete.

A8.2 Production Profile

There are seven EU-based producers/suppliers of chlorfenvinphos listed in the Chemicals and Companies Database (RSC, 1998). However, production volumes are unknown.

A8.3 Market Profile

Chlorfenvinphos is reported to be on the market in all Member States except Finland and Greece (CEC, 2000d).

Chlorfenvinphos used to be used as a sheep dip agent in the UK but the authorisation for such use was withdrawn in 1994 (DoH, n.d.).

It is used as an insecticide and aracicide. It is reportedly suitable for a limited number of crop types, including brassicas, carrots and potatoes (Whitehead, 1999).

No information has been found on the level of use of chlorfenvinphos in the EU.

Chlorfenvinphos was reportedly widely used in the USA until 1991, when all products containing chlorfenvinphos as an active ingredient were cancelled (ATSDR, 1997).

Due to the lack of information on the levels of use of chlorfenvinphos in the EU, the effects of its inclusion as a PHS must be classified as unpredictable. However, given that its use has been phased out in the USA, it is like that it could also be phased in the EU within the 20 year timetable and hence the effects could be negligible.

Table A8.1: Summary Information for Chlorfenvinphos	
Regulatory Profile	
Status of regulation	Assessment under 91/414/EEC incomplete
Production Profile	
Quantities	Unknown
Affected companies	Manufacturers <10 Formulators <10 Users Unknown
Value of products	Unknown
Market Profile	
Nature of use and associated quantities	Used as insecticide on limited number of crops
Employment	Unknown
Substitutes & substitution	Substitutes probably available as withdrawn from use in USA
Consumers	Unknown
Use value of products	As with other pesticides, has implications for food production

Table A8.2: Assessment of Uncertainty and Socio-Economic Costs for Chlorfenvinphos	
Uncertainty	Quantities used, values, substitutes
Qualitative assessment of socio-economic costs	Unpredictable (but may be negligible over 20 years)

A9. CHLORPYRIFOS

A9.1 Regulatory Profile

Chlorpyrifos was first registered for use in 1965. It is an insecticide, aracicide and nematicide. Chlorpyrifos is registered for use in all Member States except Finland and Sweden (CEC, 2000d).

Risk assessment under Directive 91/414 is currently ongoing.

Chlorpyrifos is actually recommended as an alternative to some of the pesticides which are on the POPs list, such as DDT.

A9.2 Production Profile

There are two production sites with in the EU (in the UK and Denmark) with a total production of 3-4,000 tpa. Use within the EU is around 1,000 tpa and the remainder is exported. The global organophosphate (OP) insecticide market is worth around 3 billion Euro and chlorpyrifos is the leading OP insecticide (Dow AgroSciences, 2000d).

A9.3 Market Profile

Chlorpyrifos is a broad-spectrum insecticide used on caterpillar and sucking pests in both foliar and soil applications. Industry reports that there are no suitable alternatives for control of scale pests citrus fruits in Spain, Italy and Greece; for control of leafhoppers on vines in France, Spain and Italy; and for control of root flies on brassicas in the UK.

Table A9.1 indicates the percentages in which chlorpyrifos is used on different types of crops in a number of Member States.

Table A9.1: Percentage Sales of Chlorpyrifos According to Crop Type in Five Member States

Crop Type	Spain/Portugal	France	Italy	Greece
Pome & stone fruits	8%	17%	28%	32%
Grape	6%	62%	20%	12%
Citrus	33%		8%	21%
Maize/cereals	11%		16%	
Vegetables (e.g. cauliflower)	17%	21%	22%	20%
Total	**75%**	**100%**	**82%**	**85%**

Source: Dow AgroSciences (2000b)

Other, non-agricultural uses include termite and general pest control, professional turf application, homeowners and use in nurseries and greenhouses (Kiely, 2000).

Table A9.2: Summary Information for Chlorpyrifos	
Regulatory Profile	
Status of regulation	Undergoing risk assessment under 91/414/EEC
Production Profile	
Quantities	3-4,000 tpa
Affected companies	Manufacturers <10 Formulators <10 Users >1000 Shift in activity to outside EU since 3,000 tpa exported
Value of products	Several million Euro Moderate as compared to total turnover
Market Profile	
Nature of use and associated quantities	Used as agricultural and non-agricultural pesticide
Employment	Shift in activity to outside EU (dependent upon alternatives adopted)
Substitutes & substitution	Unknown
Consumers	Potential increased cost of food. Also costs due to pest damage in other areas
Use value of products	Depending upon substitutes, has key implications for human health and also food production Time dependence upon chlorpyrifos unknown

Table A9.3: Assessment of Uncertainty and Socio-Economic Costs for Chlorphyrifos	
Uncertainty	Availability and suitability of substitutes
Qualitative assessment of socio-economic costs	Unpredictable

A10. 1,2-DICHLOROETHANE

A10.1 Regulatory Profile

Emission limit values and quality standards have been published for 1,2-dichloroethane (also referred to as ethylene dichloride, EDC) in daughter Directives under Directive 76/464/EEC. Limit values for drinking water have been established under Directive 98/83/EC and it is also controlled as a VOC under Directive (1999/13/EC).

A10.2 Production Profile

Industry data indicate that production of EDC was 8,800,000 tpa in 1998 (Eurochlor, 2000b). The direct value of this product is expected to be several billion Euros. Around 25,000 people are employed directly in the industry.

A10.3 Market Profile

Of the 8.8 million tpa produced in the EU, the majority is used in the production of vinyl chloride (VCM) for PVC manufacture. This represents over 95% of EDC use, with the remainder being used in the manufacture of ethylene amines, trichloroethylene, perchloroethylene and as an extraction and cleaning solvent and also possibly as a lead scavenger for petrol (Eurochlor, 2000b).

The Chemicals and Companies Database (RSC, 1998) reports that the use sectors for EDC include coatings, paints and inks; speciality chemicals; plastic and rubber products; and polymers and elastomers.

82 EU-based producers or suppliers are reported in the Chemicals and Companies Database (RSC, 1998). Some of these are very large chemical producing companies whereas others are relatively small suppliers.

In terms of the PVC industry (the major use for EDC), this comprises more than 21,000 companies and employs over 530,000 people, with an annual turnover of more than 72 billion Euros (CEC, 2000b).

There is no doubt that the economic implications of a ban would be extensive both for production and use of EDC.

Table A10.1: Summary Information for 1,2-Dichloroethane	
Regulatory Profile	
Status of regulation	Various emission and concentration limits
Production Profile	
Quantities	Nearly 9 million tpa produced
Affected companies	Manufacturers <50? Formulators >50 Users >1000 (finished products) Producers mainly large. Some suppliers smaller. Many SMEs amongst formulators and users
Value of products	Several billion Euros (value compared to turnover significant)
Market Profile	
Nature of use and associated quantities	95% in manufacture of VCM for PVC and various other uses.
Employment	Definite shift in activity away from EU
Substitutes & substitution	No known substitutes for VCM manufacture. Probably possible for some uses as a solvent but implications unknown
Consumers	Increase in costs very likely
Use value of products	Many critical applications amongst PVC products and will likely continue to be so over the 20 year timetable

Table A10.2: Assessment of Uncertainty and Socio-Economic Costs for 1,2-Dichloroethane	
Uncertainty	Necessity for use in applications other than VCM production
Qualitative assessment of socio-economic costs	Extensive

A11. DICHLOROMETHANE

A11.1 Regulatory Profile

Dichloromethane (DCM[3]) is on the 'candidate list' of substances under Directive 76/464/EEC and, as such, Community-wide emission limits or quality standards have not yet been developed. It is also covered as a VOC under Directive 1999/13/EC.

A11.2 Production Profile

1999 sales in Europe totalled 149,000 tonnes, as compared to 200,000 tpa in 1984 (reportedly due to more efficient use, increased recycling and replacement in some applications). There are ten production sites located in six Member States. Exports of DCM are estimated to be 100,000 tpa (and thus total EU production could be as much as 250,000 tpa). DCM is reported by industry to represent a direct business value of 125 mEUR (Eurochlor, 2000c). A ban on DCM could thus have extensive costs.

A11.3 Market Profile

DCM is an industrial solvent used in applications including:

- paint stripping;
- preparation of coated plastics (adhesives);
- as a process solvent for chemical reactions (cellulose ester production, fibre and film forming, polycarbonate production);
- purification and isolation of intermediates or products in the manufacture of pharmaceuticals and fine chemicals; and
- extraction of material from food and beverage products (e.g. the decaffeination of coffee).

It is also used in aerosols, foam blowing, chemical processing and as a secondary refrigerant medium.

It is known that certain companies using DCM as a blowing agent in polyurethane (PUR) foams would experience considerable difficulties in finding alternative products (there are alternative blowing agents but not necessarily for all types of PUR foam).

The values of the affected downstream markets is considerable.

[3] Also referred to commonly as methylene chloride.

Table A11.1: Alternative Substances and Processes for Dichloromethane		
Use	**Alternative Chemicals**	**Alternative Processes**
Paint stripping	Dibasic esters, xylene, acetone, ketone mixtures, furfuryl alcohol, n-methyl pyrrolidone	Cryogenic stripping, abrasive blasting, burn-offs, hot air guns/blowtorches, oxidative degradation in mineral acids
Pharmaceutical industry	Non-halogenated solvents, water-based solutions	N.D.
Food industry	Ethanol, methanol, diethylether, ethylmethylketone, acetone, low boiling hydrocarbons, water-based solutions	Fluid extraction, pressing processes
Polyurethane industry	Ethanol, isopropanol, carbon dioxide	N.D.
Metal industry	Alkaline cleaning systems, ethanol, isopropanol, petroleum products, ketones, esters, terpenes	Ultrasound techniques
N.D. = Not Determined Source: OECD (1994) Note: these alternatives will not be suitable for all applications		

An OECD Monograph on DCM (OECD, 1994) reports various available substitute chemicals and processes that have been employed. These are reproduced in Table A11.1. However, the report also states that:

> "The possible alternatives listed ... have not been evaluated from a toxicological or ecotoxicological point of view. The use of alternative chemicals or processes may pose other risks to human health or to the environment. It is therefore important to evaluate and compare risks carefully before making substitutions. It is also important to investigate in each case whether a particular substitute can be used, with regard to its technical efficacy" (OECD, 1994).

Table A11.2: Summary Information for Dichloromethane	
Regulatory Profile	
Status of regulation	Covered by VOCs Directive
Production Profile	
Quantities	Up to 250,000 tpa
Affected companies	Manufacturers <50 Formulators >50 Users >1000 Many industries amongst formulators and users, including many SMEs
Value of products	Production value is 125 mEUR (probably significant amount of total turnover)
Market Profile	
Nature of use and associated quantities	Solvent, aerosol, foam blowing agent, secondary refrigerant medium
Employment	Definite shift in activity to outside EU (including loss of exports)
Substitutes & substitution	Various substitutes suggested for various applications but not examined herein Known that substitute chemicals very problematic for some products
Consumers	Increase in costs
Use value of products	Critical applications include pharmaceuticals, food, etc. Some uses are likely to decline but many likely to continue over 20 years

Table A11.3: Assessment of Uncertainty and Socio-Economic Costs for Dichloromethane	
Uncertainty	Quantities used in specific applications. Suitability of substitutes
Qualitative assessment of socio-economic costs	Extensive

A12. DI(2-ETHYLHEXYL)PHTHALATE

A12.1 Regulatory Profile

DEHP is on the 2nd priority list under Regulation EEC No 793/93. The risk assessment (KEMI, 2000) is not yet complete but is approaching finalisation.

DEHP is covered under Annex 2 to the OSPAR Strategy with regard to hazardous substances (OSPAR, 2000).

A12.2 Production Profile

The production volume for Western Europe was 595,000 tpa in 1997. 186,000 tpa were exported and imports were calculated as 67,000 tpa. There are 12 current production sites in Europe which are mainly but not all large international chemical companies. Additionally, two companies import DEHP into the EU, one in the range 1,000 to 5,000 tpa and one 10,000 to 50,000 tpa (KEMI, 2000).

In 1999 there were about 20 companies producing about 1 million tonnes of all types of plasticisers in Europe, the three biggest accounting for about 40% of overall capacity (CEC, 2000b). Smaller companies are reported to be abandoning the products and/or being bought by larger companies.

The value of DEHP is around 800 Euro per tonne, making production worth around 500 Euro million per annum, exports 150 million Euro and imports around 50 million Euro. No information is available on imports or exports of DEHP within products. The costs of a ban would, therefore, be extensive.

A12.3 Market Profile

Consumption of DEHP was 476,000 tpa in 1997 (KEMI, 2000). DEHP represents 51% of all phthalate plasticiser use and 97% of consumption (462,000 tpa) is used as a plasticiser in polymers (mainly soft-PVC with only 2-3% used in other polymers). 3% is used in non-polymer applications such as adhesives and sealants, paints and lacquers, printing inks and capacitors. It is also used in advanced ceramic materials used for electronic and structural applications.

78% (362,000 tpa) is used in indoor applications and the remaining 100,000 tpa used in outdoor applications. The various applications for DEHP are illustrated in Table A12.1, along with the number of facilities undertaking each of the stated activities. In addition, there are 100 to 500 users of extruded PVC compound (containing DEHP).

There are several products containing DEHP with technical lifetimes over 20 years e.g. roofing materials (20 years), cables (30 to 50 years), floors (20 years). Actual lifetimes may often be longer. To prevent emissions from these would require them all to be taken out of service, at considerable expense.

There are a considerable number of sites involved in the use of DEHP for various processes, as reported in the draft risk assessment:

- 94 involved in calendering;
- 83 in extrusion for compounding PVC;
- 144 in extrusion of products;
- 136 involved in spread coating;
- 38 for other plastisols and car undercoating; and
- 27+11 sites involved in injection moulding/extrusion.

Transformation of PVC into final products is reportedly undertaken by over 21,000 small and medium sized enterprises, 90% of which have fewer than 100 employees, 5% have between 100 and 500 employees and 5% have more than 500 employees. Manufacture of flexible products (the majority of which will contain DEHP) involves around 10,000 companies producing 3.7 million tonnes of plasticised PVC and employing 260,000 people (CEC, 2000b).

In terms of substituting DEHP or plasticised PVC as a whole, there would be considerable technical and economic difficulties. Other phthalates may be suitable for some applications, but not all. There are considerable technical difficulties in using other polymer types for certain processing techniques (e.g. rotational moulding).

In terms of other plasticisers, there are substitutes available for many applications but often with relatively limited toxicity data and where suitable in technical terms, they are often more expensive. For example, certain citrates may be three times as expensive, as may some polymeric plasticisers. Adipates and benzoates are suitable for some applications but could cost 1.5 to 2 times as much (respectively). Others include trimellitates and sebacates which are also considerably more expensive (RPA, 2000d).

Table A12.1: Applications, Uses and Customers for DEHP by Process Type			
Process	**Application**	**Use (tpa)**	**No of customers**[a]
Calendering	Film/sheet and coated products Flooring, roofing, wall covering	71,400 34,748	74 20
	(Total, calendering)	106,148	94
Extrusion	Hose and profile	57,120	82
	Wire and cable Subtotal	80,920 138,040	62
	Compounding[1]	85,680	83
	(Total extrusion)	223,720	227
From compound	Footwear and misc. (injection moulding and extrusion)	83,680	?
Spread coating	Flooring General (coated fabric, wall-covering, coil coating etc)	39,032 76,160	21 115
	(Total spread coating)	115,192	136
Other plastisols	Car undercoating Slush/rotational moulding, Dip coating	7,140 9,520	11 27
	(Total other plastisols)	16,660	38
	Adhesives/sealants, rubber	11.000	
	Lacquers and paints	1,430	
	Printing ink (paper and plastics)	1,640	
	Ceramics	210	
	Total	**476,000**	

[a] No of customers buying neat DEHP
Source: KEMI (2000)

Table A12.2: Summary Information for Di(2-ethylhexyl)phthalate	
Regulatory Profile	
Status of regulation	ESR risk assessment close to finalisation
Production Profile	
Quantities	595,000 tpa in 1997. Significant exports
Affected companies	Manufacturers <50 Formulators >50 Users >1000 Manufacturers mainly but not all large companies. Formulators and users include many SMEs
Value of products	Possibly Euro 0.5 billion for manufacture. Even for larger companies will be a big proportion of turnover
Market Profile	
Nature of use and associated quantities	See Table A12.1
Employment	Shift in activity to outside EU
Substitutes & substitution	Substitutes for many applications. Efficacy can probably be met for many applications but cost could make unfeasible to produce. Lack of information on risks of substitutes as compared to data available on DEHP
Consumers	Increase in costs (substitutes often 3 times more expensive)
Use value of products	Many critical applications of which several expected to continue to be over 20 years

Table A12.3: Assessment of Uncertainty and Socio-Economic Costs for DEHP	
Uncertainty	-
Qualitative assessment of socio-economic costs	Extensive

A13. DIURON

A13.1 Regulatory Profile

Under Directive 91/414/EEC, Denmark is rapporteur for diuron which is on the second priority list under that Directive. Additionally, diuron is manufactured from 3,4-dichloroaniline, which is on the first priority list under Regulation EEC No. 793/93 (for which the risk assessment has not yet been completed).

A13.2 Production Profile

Diuron is produced from 3,4-dichloroaniline and, through degradation in the environment, it may also be a source of this substance via biological degradation (however, this has not been confirmed). Other phenylurea herbicides are also produced from 3,4-DCA, such as linuron, propanil and neburon.

There were 19 EU-based producers/suppliers listed in the Chemicals and Companies database (RSC, 1998). Some of these are large agrochemical companies whereas others are smaller packaging and distributing companies.

There are actually four main producers of diuron globally, producing 14,000 to 16,000 tpa in 1995 (ECPA, 2000a). The production volume in the EU is unknown.

A13.3 Market Profile

Sales of diuron in the EU are estimated by industry to be around 20% of global production, or around 3,000 tpa based on 1995 data (ECPA, 2000a). The value of this product could be expected to be several mEUR, making costs moderate. However, there could be greater costs associated with a loss of food production.

It is used in herbicidal weed control on non-cropped land (Croner, 1999). It is reported to be registered for use in all Member States except Sweden and Finland (CEC, 2000d).

Table A13.1: Summary Information for Diuron	
Regulatory Profile	
Status of regulation	Assessment under 91/414 ongoing
Production Profile	
Quantities	Around 3,000 tpa
Affected companies	Manufacturers <10 Formulators <50 Users >1000? Many SMEs amongst users
Value of products	Unknown
Market Profile	
Nature of use and associated quantities	Unknown
Employment	Possible shift in activity to outside EU
Substitutes & substitution	Unknown
Consumers	Unknown effects but potential effects upon food supply
Use value of products	Unknown

Table A13.2: Assessment of Uncertainty and Socio-Economic Costs for Diuron	
Uncertainty	Specific areas of use and values; substitutes
Qualitative assessment of socio-economic cost	Unpredictable

A14. ENDOSULFAN

A14.1 Regulatory Profile

Endosulfan is being reviewed under Directive 91/414/EEC. The assessment is not yet complete. It is on the candidate list under Directive 76/464/EEC and no Community-wide limit values or emissions standards have been developed.

Endosulfan is also covered under Annex 2 to the OSPAR Strategy with regard to hazardous substances (OSPAR, 2000).

A14.2 Production Profile

Production of endosulfan is reported to be around 8,000 tpa. The majority of this (7,600 tpa) is exported for use in subtropical and tropical conditions (such as Latin America and SE Asia) (AgrEvo, 1999).

There are ten EU-based producers or suppliers reported in the Chemicals and Companies database (RSC, 1998). However, there is reported to be only one company producing endosulfan in the EU (Aventis, 2000a).

A14.3 Market Profile

Endosulfan is an insecticide with acaricidal properties (Whitehead, 1999). It has been registered in Europe for over 40 years (Aventis, 2000a).

Figure A14.1 illustrates the reduction in use of endosulfan over the period from 1994 to 1999, based upon data provided by industry. Use in 1999 was 461.7 tonnes (AgrEvo, 1999). Cost implications of a ban for the EU market might thus be considered to be moderate (although the potential loss of food production should also be taken into account), whilst that of the exports would be extensive.

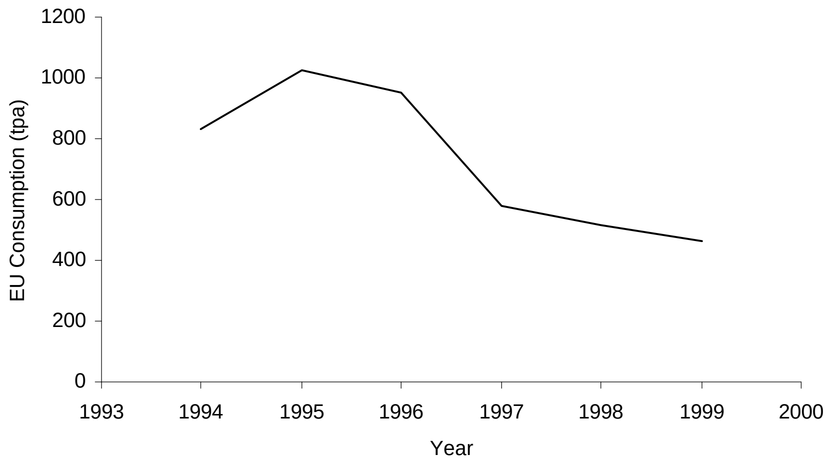


Figure A14.1: EU Consumption of Endosulfan (Aventis, 2000a)

Consumption has, therefore, declined significantly in recent years. It was reportedly only used in seven EU countries in 1999, as illustrated in Figure A14.2. Use is confined mainly to Southern Europe.

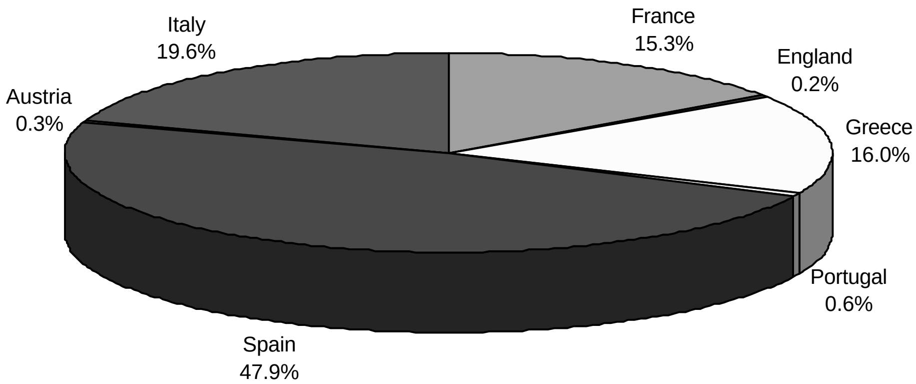


Figure A14.2: Member States using Endosulfan in 1999 (Aventis, 2000a)

Endosulfan is used on products such as cotton, citrus, grapes, sugar beet, potatoes, curcubits, solanacea, pome and stone fruits.

In general, there appear to be substitutes for a majority of applications, as illustrated by the decline in use of Endosulfan. However, there are reportedly certain uses where there are no immediately available alternatives (Aventis, 2000b). Within the 20 year timetable, it is probable that substitutes will be available for those uses.

However, it is not necessarily true that substitutes could be adopted in non-EU countries, nor that those countries would choose to use any substitute. Given the high level of exports, there is the potential for moderate to extensive economic impacts if production in the EU is forced to cease in the immediate future.

Table A14.1: Summary Information for Endosulfan	
Regulatory Profile	
Status of regulation	Assessment under 91/414/EEC not yet complete
Production Profile	
Quantities	8,000 tpa
Affected companies	Manufacturers <10 Formulators <10 Users >1000 Users will include various SMEs. Suppliers also include SMEs
Value of products	Several million Euros
Market Profile	
Nature of use and associated quantities	Insecticide on various crops (462 tpa)
Employment	Loss of exports and employment to outside EU due to significant exports
Substitutes & substitution	Substitutes possible for some crops but not others, especially those in (sub)tropical countries
Consumers	Possible increase in cost of food
Use value of products	Dependent upon substitutes (key implications for human health and food production)

Table A14.2: Assessment of Uncertainty and Socio-Economic Costs for Endosulfan	
Uncertainty	Specific crops, substitutes
Qualitative assessment of socio-economic costs	Extensive in short term, declining over 20 years

A15. HEXACHLOROBENZENE

A15.1 Regulatory Profile

HCB is prohibited for use as a plant protection product (PPP) under Directive 79/117/EEC. It is listed under the POPs Protocol and is hence subject to international controls on its use as a pesticide.

Emission limits and quality standards have been developed under Directive 76/464/EEC.

HCB is a contaminant of various other products and processes. Various programmes to reduce emissions are already in place or being introduced (such as an ECVM agreement to reduce emissions from EDC/VCM/PVC production and emission limits under Directive 76/464/EEC). Chlorinated hydrocarbons including HCB are also the subject of emission limit values under OSPAR Decision 98/4 on Emission and Discharge Limit Values for the Manufacture of Vinyl Chloride Monomer (VCM) including the Manufacture of 1,2-dichloroethane (EDC).

A15.2 Production Profile

HCB is no longer produced or used intentionally in the EU or North America. Previous applications included use as a seed dressing and fungicide, in manufacture of aluminium and graphite rods and as an intermediate in the production of chlorinated aromatics. In 1975 HCB was reported to be produced at volumes of 15,000 tonnes per annum (BKH & TNO, 2000). It is a contaminant in pesticides such as atrazine and various chemical processes including perchloroethylene, chlorobenzenes, and other chlorinated organics such as PVC. HCB is also emitted from metals industries, combustion processes and landfills.

In terms of direct production, there would be no impacts of a ban since production no longer occurs within the EU.

A15.3 Market Profile

There are no longer any intentional uses of HCB. However, there would be extensive economic implications for the industries from which HCB is emitted (e.g. the total PVC producing and transforming industry in Western Europe comprises more than 21,000 companies and employs over 530,000 people, with an annual turnover of more than 72 billion Euros (CEC, 2000b)).

In terms of emission reduction from these industries, since there are a number of initiatives underway, some level of emissions reduction will be cost neutral. However, there is insufficient information available to quantify this.

Total cessation of emissions is likely to be impractical. Cessation of emissions from intentional use is not required since it is no longer produced.

Note that UBA (1998) report that lindane may be metabolised by plants to produce HCB at a level of 0.01%.

UNEP POPs data on alternatives lists substances such as carboxin, guazaine, bitertanol and fuberizadole for agricultural uses (no longer applicable for the EU).

Table A15.1: Summary Information for Hexachlorobenzene	
Regulatory Profile	
Status of regulation	POP. Various emission limits. Use as PPP prohibited
Production Profile	
Quantities	No production. By product of various other industries
Affected companies	Manufacturers 0 Formulators 0 Users 0
Value of products	No value (unwanted by-product)
Market Profile	
Nature of use and associated quantities	None
Employment	Potentially massive shift if include all industries in which it is an unwanted contaminant (unintentional uses)
Substitutes & substitution	Not applicable
Consumers	Potentially massive cost increases, dependent upon degree of emissions reduction or phase out. Also, many critical applications
Use value of products	None directly. Products in which is a contaminant have significant use value and are likely to continue to be important beyond 20 year timeframe

Table A15.2: Assessment of Uncertainty and Socio-Economic Costs for Hexachlorobenzene	
Uncertainty	-
Qualitative assessment of socio-economic costs	Negligible for intentional uses Extensive for non-intentional uses

A16. HEXACHLOROBUTADIENE

A16.1 Regulatory Profile

Based on Directive 76/464/EEC, emission limits and environmental quality standards have been developed for HCBD (86/280/EEC as are amended by 88/347/EEC),

A16.2 Production Profile

The 1996 IUCLID Database reports that HCBD is not produced in the EU and in relation to exposure states that:

> "Hexachlorobutadiene is not produced directly and used anymore. This by-product is collected and destroyed within the installation by up to date thermal degradation. Given the elimination of its dispersive use, environment impact has significantly been reduced over the last 10 years" (ECB, 1996).

Indeed, information from industry (Euro Chlor, 2000h) confirms that it is no longer produced in either the EU or North America. However, it is present as an unwanted by-product in various organic chemicals, in the same way as HCB is (see below).

A16.3 Market Profile

In the past HCBD was used as a solvent for rubber and other polymers, in heat transfer fluids, as a transformer liquid, a hydraulic fluid and a washing liquor for removing hydrocarbons. It has also been used as a seed dressing and fungicide for various crops. Furthermore, it was also used in the manufacture of products such as aluminium and graphite rods (Eurochlor, 2000h).

As with hexachlorobenzene, HCBD can occur in the manufacture of other substances, as an unwanted by-product. It can occur during the manufacture of substances such as carbon tetrachloride, tetrachloroethylene (as reported in ECB (1996)), vinyl chloride, allyl chloride and epichlorohydrin (Health Canada, 2000).

Thus, whilst economic implications for direct production would be negligible, if unintentional production is intended to be phased out, economic implications would be extensive. If emissions from unintentional production are to be reduced, costs will depend upon the degree of reduction required. In some cases, requirements for emissions reduction under the WFD will be cost neutral due to existing schemes to reduce overall emissions from e.g. vinyl chloride (VCM) manufacture.

It is reported that HCBD can no longer be detected in chlorinated organic chemicals on the EU market, due to changes in manufacturing processes (Eurochlor, 2000h). In this respect, emissions might also considered to be 'zero', although that could change as the detection limits of instrumentation are reduced. It is further reported that emissions of HCBD from manufacturing sites have already been considerably reduced - by a factor of 40 from 1983 to 1998 (Eurochlor, 2000h) - although details of the cost implications of these existing reductions are unknown.

Table A16.1: Summary Information for Hexachlorobutadiene	
Regulatory Profile	
Status of regulation	Emission limits under 76/464/EEC
Production Profile	
Quantities	No production. Unintentional by-product of various other industries and contaminant of products
Affected companies	Manufacturers 0 Formulators 0 Users 0
Value of products	No value (unwanted by-product)
Market Profile	
Nature of use and associated quantities	None
Employment	Potentially massive shift if include all industries in which it is an unwanted contaminant and/or by-product
Substitutes & substitution	Not applicable
Consumers	Potentially massive cost increases, dependent upon degree of emissions reduction or phase out. Also, many critical applications
Use value of products	None directly. Products in which is a contaminant have significant use value and are likely to continue to over more than 20 years

Table A16.2: Assessment of Uncertainty and Socio-Economic Costs for Hexachlorobutadiene	
Uncertainty	-
Qualitative assessment of socio-economic costs	Negligible for intentional uses Extensive for non-intentional uses

A17. HEXACHLOROCYCLOHEXANE (INCLUDING LINDANE)

A17.1 Regulatory Profile

Under Directive 91/414/EEC, it has not been included under Annex I (it has been withdrawn).

Lindane is one of the chemicals on the list for Prior Informed Consent and several countries have banned its import. It is banned in the Netherlands, Sweden and Finland.

Products containing less than 99% lindane are banned under Directive 79/117/EEC. Emissions of HCH are regulated under 84/491/EEC.

It is included under the UNECE POPs Protocol and is thus subject to a phase out for certain uses. HCH is also included under Annex 2 to the OSPAR Strategy with regard to hazardous substances (OSPAR, 2000).

A17.2 Production Profile

Lindane is effectively the only isomer that can be produced and used in the EU. Worldwide production fell from an average of 4,400 tpa in the years 1988-1993 to an average of 3,222 tpa in 1990-95 (UBA, 1998) and its use is expected to have decreased since then. European production is 5-50 tpa compared to 3,000 tpa in 1985 (BKH and TNO, 2000).

There are reported to be no EU producers of the active ingredient but it appears that there are several companies which formulate it into finished products (e.g. around 15 listed on The Chemical Directory (CIA, 2000)).

A17.3 Market Profile

Use of lindane as a PPP is not authorised for use in six Member States: Finland, Sweden, Denmark, Germany, Austria and France (CEC, 2000d). Use is as an insecticide for seed treatment and treatment of soil with subsequent incorporation into the top soil layer. Self-imposed use restrictions are supported by CIEL for all other uses, especially foliar spraying. Global production of CIEL-quality lindane (>99.5%) is around 900 tpa.

Other uses include industrial wood treatment; cattle dipping or spraying; medical treatments (lice, scabies, etc.); and treatment of plants and soil in Agriculture and Forestry (IUCLID).

Technical HCH (i.e. HCH mixed isomers) is restricted to use as an intermediate in chemical manufacturing. Products in which at least 99% of the HCH isomer is in the gamma form (i.e. lindane, CAS: 58-89-9) are restricted to the following uses:

- seed treatment;
- soil applications directly followed by incorporation into the topsoil surface layer;
- professional remedial and industrial treatment of lumber, timber and logs;
- public health and veterinary topical insecticide;
- non-aerial application to tree seedlings, small-scale lawn use, and indoor and outdoor use for nursery stock and ornamentals; and
- indoor industrial and residential applications (POPs Protocol - Annex II - Substances Scheduled for Restrictions on Use).

Data published by the Pesticide Usage Survey Group of the UK Ministry of Agriculture, Fisheries and Food (MAFF) from 1995/96 suggested that lindane use as a seed treatment was rising, its use in horticulture was falling and use in grain stores had virtually disappeared.

Due to its use as a pesticide, it will not be possible to eliminate the emissions of lindane to zero without a ban upon its use. However, as it is not included in Annex 1 to 91/44/EEC, this decision has already been taken in the Community.

We have insufficient information to assess whether it is used extensively in the EU.

Table A17.1: Summary Information for Hexachlorocyclohexane	
Regulatory Profile	
Status of regulation	Only lindane can be used other than as chemical intermediate Not on Annex 1 to 91/414/EEC.
Production Profile	
Quantities	Possibly 5-50 tpa produced (may be 0)
Affected companies	Manufacturers <10 Formulators <10 Users unknown Size distributions unknown but formulators generally large
Value of products	Unknown
Market Profile	
Nature of use and associated quantities	Used as insecticide, seed treatment
Employment	Probably little shift to outside EU for formulation of products
Substitutes & substitution	Some available but vary according to use. Not examined in detail yet
Consumers	Potential for increased food costs
Use value of products	Depending upon substitutes, has key implications for human health and also food production Time dependence unknown

Table A17.2: Assessment of Uncertainty and Socio-Economic Costs for Hexachlorocyclohexane	
Uncertainty	Lack information on EU use of lindane
Qualitative assessment of socio-economic costs	Moderate

A18. ISOPROTURON

A18.1 Regulatory Profile

Isoproturon is undergoing assessment under Directive 91/414/EEC but this is not yet complete.

A18.2 Production Profile

Like some of the other pesticides, there is little available information on production and use (where such data are not provided by industry).

There are five reported producers/suppliers listed in the Chemicals and Companies database. There are thought to be two main producers in the EU, based in France and Germany.

A18.3 Market Profile

Isoproturon is reported to be the second most widely applied pesticide in the UK in terms of tonnes applied: there were 2,382 tpa applied in 1997 (Newbould *et al*, 1998). Usage in the UK in terms of the weight applied is given in Figure A18.1. It is authorised for use in all Member States except Finland (CEC, 2000d).

Figure A18.1: Application of Isoproturon in the UK (DETR, 1999a)

Isoproturon is a selective, systemic herbicide used in the control of annual grasses and broad-leaved weeds in cereals (WHO, 1993). It is used in a wide variety of different commercial products. For example, it is used in 37 products licensed in Ireland (Clean

Technology Centre, 1999) and 19 products are listed for sale in the UK (Whitehead, 1999).

It is reported that use of isoproturon is expected to increase in the UK (ADAS and CSL, 1999).

It is also sometimes applied in combination with other pesticide active ingredients, such as simazine, trifluralin and pendimethalin (Whitehead, 1999).

Table A18.1: Summary Information for Isoproturon	
Regulatory Profile	
Status of regulation	Assessment under 91/414/EEC incomplete
Production Profile	
Quantities	Unknown
Affected companies	Manufacturers <10 Formulators Unknown Users >1000? Users will include many SMEs
Value of products	Unknown but probably significant (2nd largest pesticide use UK)
Market Profile	
Nature of use and associated quantities	Quantities unknown. Used on cereals (esp. winter wheat and barley)
Employment	Unknown effects
Substitutes & substitution	Unknown
Consumers	Potential for increased food costs
Use value of products	Depending upon substitutes, has key implications for human health and also food production Time dependence unknown

Table A18.2: Assessment of Uncertainty and Socio-Economic Costs for Isoproturon	
Uncertainty	Quantities, values, substitutes
Qualitative assessment of socio-economic costs	Unpredictable

A19. LEAD

A19.1 Regulatory Profile

Marketing and use restrictions have been introduced for the use of lead in most paints through Directive 89/677/EEC. Limit values for lead in drinking water and sewage sludge have been introduced as well as legislation regarding lead in ambient air.

Batteries containing lead are also covered by Directive 91/157/EEC on batteries and accumulators containing certain dangerous substances.

Under the proposed WEEE Directive, it is proposed that lead is substituted by other substances by 2008 in electronic and electrical equipment (CEC, 2000c).

A phase out on the use of lead in petrol has been agreed under the UN-ECE protocol.

There are also various risk management activities in place concerning a number of applications and possible concerns (at the European or national level). These are considered in detail in a report by the OECD (1999) and include the following:

- lead in petrol (generally being phased out);
- exposure of children (migration limits from consumer products);
- prohibition of use in some food packaging;
- concentration limits for ceramics;
- prohibition of the use of lead shot in some areas;
- drinking water limits;
- limits in packaging and packaging waste;
- occupational exposure limits; and
- reduction of emissions to air and limits in ambient air.

Lead is included under Annex 2 to the OSPAR Strategy with regard to hazardous substances (OSPAR, 2000).

A19.2 Production Profile

EU production of lead was 1,556,000 tonnes in 1999 of which 652,000 tonnes was primary production and 904,000 tonnes was from recycling (Eurometaux, 2000).

A19.3 Market Profile

Total consumption of refined lead was 1,703,000 tonnes in 1999 and an additional 120,000 tonnes was recovered from secondary materials and used directly in products. Total consumption was around 1,820,000 tonnes (Eurometaux, 2000).

Table A19.1 indicates the total quantities used in each of the major applications for lead in 1999.

Table A19.1: Applications and Quantities of Lead Used in 1999		
Application	**Tonnes**	**Percent**
Batteries (cars and emergency power applications)	1,055,600	58
Rolled products (roofing, radiation shielding)	254,800	14
Compounds (stabilisers, ceramic glazes, glass for TV tubes, computer monitors)	218,400	12
Shot (cartridges, steel making)	72,800	4
Weights	72,800	4
Alloys (solders, brass making)	54,600	3
Cable sheathing (power cables)	54,600	3
Gasoline additives (mostly exported)	36,400	2
Total	**1,820,000**	**100**
Source: Eurometaux (2000)		

In terms of lead stabilisers, around 112,000 (around 3% of the total lead consumption) tonnes were used in Europe in 1998, containing about 51,000 tonnes of lead metal and representing 70% of total stabiliser consumption.

As with other metals, there are various non-intentional emissions since lead is naturally occurring and is a constituent of various substances. It would essentially be impossible to totally cease emissions of lead without having extensive economic implications.

There are reported to be no suitable substitutes for lead acid batteries for use in cars and emergency power sources (the major application for lead (Eurometaux, 2000)).

Substitutes are available for certain other applications, such as some (but possibly not all) uses of lead as a stabiliser. For example, calcium/zinc stabilisers can be used for some applications but at an increased cost and with reduced efficacy in some cases (depending upon the application in question).

Table A19.2: Summary Information for Lead	
Regulatory Profile	
Status of regulation	Use restricted and various emission/concentration limits in place
Production Profile	
Quantities	1,556,000 tpa
Affected companies	Manufacturers <50? Formulators >50 Users >1000 Includes many SMEs (e.g. any companies using cars)
Value of products	Many millions or billions of Euros and significant proportion of turnover for many companies
Market Profile	
Nature of use and associated quantities	See Table A19.1
Employment	Potentially massive shift in employment if all emissions required to be phased out
Substitutes & substitution	No substitutes for certain applications (esp. batteries, the major use) More expensive in other applications
Consumers	Large increases in costs
Use value of products	Power cells for hospitals, and radiation shielding are just two examples of critical applications Will probably continue to be important in several applications beyond 20 years

Table A19.3: Assessment of Uncertainty and Socio-Economic Costs for Lead	
Uncertainty	Producing companies (including recycling)
Qualitative assessment of socio-economic costs	Extensive

A20. MERCURY

A20.1 Regulatory Profile

Environmental quality standards and emission limits have been set under amendments to Directive 76/464/EEC (Directive 82/176/EEC controls emissions from the chlor-alkali electrolysis industry and 84/156/EEC for other industries). Its use as a PPP was prohibited by Directive 79/117/EEC and its marketing and use has been restricted for certain applications.

There are also various OSPAR activities relating to the reduction of emissions of mercury (e.g. emissions from 'various sources', the chlor-alkali industry, etc.). It is included under Annex 2 to the OSPAR Strategy with regard to hazardous substances (OSPAR, 2000).

A20.2 Production Profile

Production of mercury has reduced significantly over recent decades (e.g. global production was 10 kt in 1970, 5.5 kt in 1990 and 3.65 kt in 1991). Secondary production may be 40% or more of primary production. The drop in world production has been accompanied by a drop in its price (OECD, 1995). By 1997, global production had fallen to around 2,000 tpa (Eurochlor, 2000a). There are 21 suppliers of mercury listed in the Chemical Directory (CIA, 2000).

European production of mercury was reported to be 400 tpa in 1997 (Eurochlor, 2000a).

A20.3 Market Profile

Uses for mercury are many and the relative proportions vary amongst countries. For example, OECD uses include:

- batteries, range 3 to 69 per cent (average 25%);
- chlor-alkali industry, range 2 to 78 per cent (average 28 per cent);
- electrical equipment and measurement equipment, range 1 to 50% (average 16%);
- paint, range 0.1 to 16 per cent (average 10%);
- tooth fillings, range 2 to 51 per cent (average 7%); and
- all other uses, such as thermometers, laboratory uses, and others, (average 14%).

If all emissions were to be prohibited, this would lead to the cessation of, for example, the production of chlorine using one of the available processes. It has been suggested that this use will be phased out within 20 years in any case so that the WFD may be cost neutral.

Due to the various other initiatives to reduce use and emissions, a certain level of emission reduction will likely be cost neutral.

In addition, there are a great number of other sources of mercury that would need to be controlled (or ceased) if emissions are to be reduced to zero. These include all forms of power generation using fossil fuels and other incineration processes. To reduce emissions to zero from all of these sources would have extensive economic and social implications.

Table A20.1: Summary Information for Mercury	
Regulatory Profile	
Status of regulation	Emission limits under 76/464 also for drinking water and sewage sludge Certain uses restricted under marketing and use Directive (e.g. banned for use as PPP)
Production Profile	
Quantities	400 tpa
Affected companies	Manufacturers <10 Formulators <50 Users >1000 Many SMEs amongst users
Value of products	Unknown but significant
Market Profile	
Nature of use and associated quantities	Few hundred tonnes. Used in batteries, chlor-alkali industry, electrical equipment, paint, tooth fillings, thermometers, laboratory uses
Employment	Probable shift to outside EU, especially for some uses. Massive effects if include unintentional/natural emissions
Substitutes & substitution	Alternatives available for most but not all uses Efficacy poor for some uses
Consumers	Probable increases in costs in some areas
Use value of products	Products will continue to be important but substitution will be possible for some

Table A20.2: Assessment of Uncertainty and Socio-Economic Costs for Mercury	
Uncertainty	Costs of reducing emissions
Qualitative assessment of socio-economic costs	Moderate. Extensive if include unintentional sources

A21. NAPHTHALENE

A21.1 Regulatory Profile

Risk assessment under Regulation EEC No. 793/93 has not yet been completed but has reached the draft stage (Environment Agency, 1999a). A draft risk reduction strategy has been prepared to address the aforementioned risk (RPA, 2000e).

A21.2 Production Profile

The primary source of naphthalene is through the distillation of coal tar (of which naphthalene makes up around 10% w/w). Other fractions are also produced which can contain naphthalene and which are further processed to separate commercially viable chemicals such as anthracene from anthracene oil or are used in blends, such as for road tar production. Additionally, drained oils remaining from this further processing are then blended to produce creosote, which may contain up to 25% naphthalene. Any remaining oils (which may contain about 4% naphthalene) may be sold for the manufacture of carbon black. Some producers may supply heating oils containing up to 10% naphthalene (Environment Agency, 1999a). Additionally, one EU company produces naphthalene from petroleum.

The risk assessment has estimated that EU production of naphthalene is 200,000 tpa. The relevant companies are located in the UK, Belgium, France, Italy, Netherlands, Denmark, Germany, Austria and Spain. Production figures from individual producers ranged from 4,000 to 70,000 tonnes per annum. However, there is an additional 10,000 tpa of naphthalene present in distillates used for the production of creosote and an unestablished amount as a constituent of oils used for carbon black manufacture or in heating oils.

There are also a number of distributors throughout the EU acting as agents for naphthalene produced in the EU or from elsewhere in the world.

Imports of naphthalene into the EU are relatively small. However, up to 25% of production is exported, making use in the EU around 150,000 tpa.

A21.3 Market Profile

Naphthalene is used in a variety of applications, as outlined in Table A21.1.

Table A21.1: EU Uses of Naphthalene			
Use	**Description**	**Companies**	**Use (tpa)**
Phthalic anhydride	As feedstock.	3	40,000
Dyestuffs	In manufacture of azo dyes	?	46,000
Naphthalene sulphonic acids	Manufacture of plasticisers for concrete (main use), manufacture of an ingredient for plasterboard, as dispersants in synthetic and natural rubbers and in tanning agents for the leather industries	10-15	24,000
Alkylated naphthalene solvents	-	1	15,000
2-napthol	Intermediate in manufacture of azo dyes	1	12,000
Creosote	Wood preservative	10 producers	10,000
Moth balls	Moth repellent	2	1,000
Pyrotechnics	Special effects for the film industry	8	15
Grinding wheels	As pore forming agent	4+	350
Others	Synthesis of chemicals including pharmaceuticals and pesticides	?	4,000
Total			**152,365**
Source: Environment Agency (1999a)			

Certain uses rely specifically on naphthalene whilst for others there are available substitutes. However, it is known that such substitutes are frequently more expensive, less efficacious or are potentially at least as hazardous (e.g. use in grinding wheel manufacture, presence in creosote). Also, in relation to creosote, there would be extensive cost and efficacy implications associated with removing naphthalene from products. It is considered that the economic costs of a ban for the intentional uses would be extensive.

Note that the risk assessment identifies other sources than the above deliberate uses as the most significant sources of naphthalene in the environment. In particular, combustion sources are responsible for the highest measured levels in the environment (around heavily industrialised areas). Vehicle exhausts are the biggest source. Naphthalene may also be released through various other activities such as during the production of aluminium and from oil refineries and offshore drilling activities as well as through natural combustion sources. The potential economic implications of requiring zero emissions for these sites would be enormous and unachievable .

Table A21.2: Summary Information for Naphthalene	
Regulatory Profile	
Status of regulation	Risk assessment under Reg. 793/93 nearly completed and risk reduction strategy drafted
Production Profile	
Quantities	200,000 tpa (also produced unintentionally and as part of other products)
Affected companies	Manufacturers <10 Formulators >50 Users >1000 Users and formulators include many SMEs
Value of products	Several million Euros
Market Profile	
Nature of use and associated quantities	See Table A21.1
Employment	Shift in activity from EU
Substitutes & substitution	No substitutes for some applications. Some substitutes potentially more environmentally damaging and/or less efficacious
Consumers	Probable increase in costs
Use value of products	Critical applications include pharmaceuticals. Likely to continue to be important in the future

Table A21.3: Assessment of Uncertainty and Socio-Economic Costs for Naphthalene	
Uncertainty	Values of finished products
Qualitative assessment of socio-economic costs	Extensive

A22. NICKEL

A22.1 Regulatory Profile

Nickel is on the third priority list for risk assessment under Regulation EEC No. 793/93. This risk assessment is not yet complete. The Danish competent authority has been contacted in this respect although no response has been received.

A limit value for drinking water has been introduced under Directive 98/83/EC and for sewage sludge under 86/278/EEC. Furthermore, its use in certain skin contacting products has been prohibited due to its sensitising effects in certain people (through amendment to Directive 76/769/EEC).

A22.2 Production Profile

10 suppliers were listed in the Chemicals and Companies database (RSC, 1998). There are reportedly over 300 organic and inorganic nickel compounds listed in EINECS, of which only five were selected for risk assessment under Regulation 793/93 (ECB, 2000a).

European production of nickel was 193,000 tpa in 1999, of a global total of 1,032,000 tpa (INSG, 2000). This is estimated to have a value of 1.3 billion Euros based upon the price of nickel in July 1999 (Anyadike, 1999).

A22.3 Market Profile

As compared to production, European demand for nickel in 1999 was 402,000 tpa, compared to a total global demand of 1,077,000 tpa (INSG, 2000).

Nickel is used in over 300,000 products for consumer, industrial, military, transport, marine and architectural applications. In terms of the first use of nickel, around 57% is used in stainless steel, 16% in non-ferrous alloys, 11% in alloy steels, 7% in plating, 5% in foundry alloys and 4% in others (chiefly batteries and catalysts). Therefore 89% of primary nickel use is in the manufacture of nickel containing alloys. The main end uses for nickel are as follows:

- 43% goes into industrial uses including the chemical industry, food processing, vessels and tanks and energy production;
- 26% is used in commercial applications (including consumer products), particularly white goods and electronics but also including domestic cookware, medical appliances and coinage;
- 24% is used in transportation applications (of which around two thirds is in automobiles with other uses including aerospace, marine and rail transportation); and
- the remaining 7% is used in building and construction which includes fasteners, sinks and baths, street furniture and chimney liners.

Globally, around 25% of total demand is met through recycling, mainly being used in the stainless steel industry (and thus the percentage used overall in stainless steels is higher than the figure quoted).

Use of stainless steel is expected to grow in the coming years, with a consequent increase in the use of nickel. Additionally, many aircraft engines consist of over 30% nickel, and annual growth in this area is expected to be 5.3% until the year 2015 (Anyadike, 1999).

There are various other sources of nickel in the environment, including natural sources such as weathering of rocks (it is the fifth most abundant metal on earth) and its presence in soils, foodstuffs, etc. and also unintentional emissions through combustion sources.

There are many applications where there are no suitable alternatives for nickel and indeed since it is present in a vast number of products and processes due to its natural occurrence, emissions during the lifetime of products could never feasibly be prohibited (nor in many cases reduced).

There are a great many safety, health and environment critical applications for nickel. For example, nickel may constitute up to 58% w/w in certain alloys used in safety critical nuclear power engineering components (Anyadike, 1999).

Furthermore, nickel is used in certain applications as an alternative to other potentially hazardous substances. For example, NiMH batteries have been developed as alternatives to some NiCd rechargable batteries. NiMH batteries are also particularly suitable for use in electric and hybrid vehicles, which are being encouraged by the European Commission (Anyadike, 1999).

Socio-economic implications of prevention of use of nickel would undoubtedly be extensive for a majority of applications.

Table A22.1: Summary Information for Nickel	
Regulatory Profile	
Status of regulation	Banned for use in some skin contact applications (e.g. jewellery). Risk assessment under Regulation 793/93 incomplete
Production Profile	
Quantities	193,000 tpa (secondary production will probably increase further)
Affected companies	Manufacturers <50 Formulators >50 Users >1000 'Formulators' and users will include many SMEs
Value of products	Direct value of Ni is 1.3 billion Euros per annum
Market Profile	
Nature of use and associated quantities	Transportation (24%), commercial (26%), industrial (43%) and building/construction (7%)
Employment	Shift in activity from EU
Substitutes & substitution	No substitutes for many applications
Consumers	Definite increase in costs and loss of many products
Use value of products	Many critical applications both now and in future

Table A22.2: Assessment of Uncertainty and Socio-Economic Costs for Nickel	
Uncertainty	Value of downstream markets (but known to be high)
Qualitative assessment of socio-economic costs	Extensive

A23. NONYLPHENOLS

A23.1 Regulatory Profile

Under Regulation EEC No 793/93, a risk assessment for nonylphenol (NP) has been completed but not yet published at the European level (Environment Agency, 1999c). Furthermore, a risk reduction strategy has also been completed but also not yet published (RPA, 2000b).

NP is also covered under Annex 2 to the OSPAR Strategy with regard to hazardous substances (OSPAR, 2000).

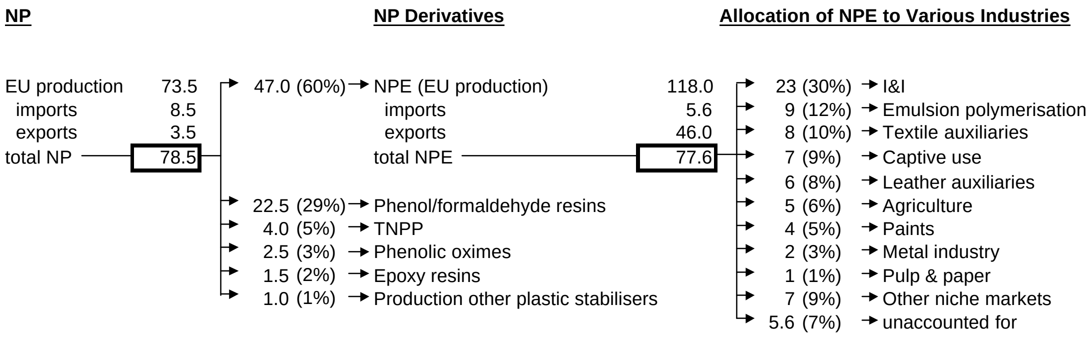
A23.2 Production Profile

EU production of NP was 73,500 tpa in 1997, produced by four companies. Additionally, 8,500 tonnes were imported and 3,500 tpa exported (Environment Agency, 1999c).

In terms of the direct value of NP to the producers, this will be of the order of tens of millions of Euros.

A23.3 Market Profile

Of NP production, a large proportion was used in production of nonylphenol ethoxylates (NPEs), which in turn are used in a variety of industries. Uses of NP and NPEs are indicated in Figure A23.1 (from RPA, 2000b).



Based on data provided by Contensio

Figure A23.1: NP & NPE Market in Western Europe in 1997 (kt) (RPA, 2000b)

Use in a number of sectors is understood to be decreasing, although use in others will have remained relatively constant. It is anticipated that use in certain sectors will not continue to be important within the 20 year timeframe relevant to this investigation.

If the risk reduction strategy is taken forward as anticipated, no additional costs will be incurred for those sectors where marketing and use restrictions have already been proposed[4]. However, for other sectors, there are potentially very significant cost implications, as evidenced by cost estimates provided by industry (Table A23.1).

Table A23.1: Nonylphenols, Octylphenols and their Ethoxylates: Estimate of Approximate Costs to EU Industry (Euro 1999*)

Uses	Estimated Consumption (1995) (kt)	Estimated Number of Formulations	Reformulation Cost per Formulation (Euro 000s)	Cost of Substitution (Euro million)		Total Cost to Industry (mill Euro)
				Costlier Substitute**	Reformulation & Commercialisation	
NP/OP Chemical intermediate for resins & additives	39	2,000	69	107	137	244
NPE/OPE Industrial detergents	28	10,000	14	19	137	156
Emulsion polymerisation	12	2,000	274	8	549	557
Textile & leather processing	18	2,000	34	12	69	81
Agrochemicals	6	1,000	206	4	206	210
Other uses	16	10,000	34	11	343	354
Total		**27,000**		**162**	**1,441**	**1,603**

* Converted from 1995 ECUs
** Assumed at Euro 2.74/kg for NP/OP and Euro 0.68/kg for NPE/OPE

For certain sectors, such as use of NPEs in emulsion polymerisation, there would be highly significant cost implications (and very little environmental benefit since this industry has been assessed to contribute only 0.002% of the environmental burden attributable to NP).

[4] Those sectors which contribute most to the regional concentration and for which a ban is not considered disproportionate to the costs (industrial, institutional and domestic cleaning (I&I), textiles, leathers, agriculture (veterinary medicines), metals, pulp and paper, and cosmetics).

Table A23.2: Summary Information for Nonylphenols	
Regulatory Profile	
Status of regulation	Risk assessment completed but not published, risk reduction strategy proposed
Production Profile	
Quantities	73,500 tpa produced in 1997
Affected companies	Manufacturers <10 Formulators >50 Users >1000 Will include numerous SMEs amongst users
Value of products	Tens of millions of Euros for NP directly
Market Profile	
Nature of use and associated quantities	See Table A23.1
Employment	Potentially shift in activity to outside EU
Substitutes & substitution	Substitutes of good efficacy available for some applications at moderate cost increases. However, no suitable substitutes for certain applications where marketing & use restrictions not already being proposed (cost of hundreds of mEUR for substitution in terms of products and derivatives)
Consumers	Potentially increase in costs
Use value of products	Use of NP in spermicides is important health-critical application Several products likely to continue to be important beyond 20 years

Table A23.3: Assessment of Uncertainty and Socio-Economic Costs for Nonylphenols	
Uncertainty	-
Qualitative assessment of socio-economic costs	Extensive

A24. OCTYLPHENOLS

A24.1 Regulatory Profile

Work is currently being undertaken in the UK to examine the risks of octylphenols and other alkylphenols in a targeted manner. The results of this work are not yet available.

OP is also covered under Annex 2 to the OSPAR Strategy with regard to hazardous substances (OSPAR, 2000).

A24.2 Production Profile

Production and use of octylphenol (OP) is reported to be only 6,800 tpa, as compared to 73,500 tpa for nonylphenol.

There are several producers/suppliers of OP in the EU. For example, the Chemicals and Companies database lists six producers and/or suppliers (RSC, 1998).

A24.3 Market Profile

As with nonylphenol, a certain amount of OP is used in the production of the ethoxylates. On a global scale, OP ethoxylates represent only around 6% of global demand for alkylphenol ethoxylates (CEPAD, 1999) which would make EU use around 5,000 tonnes per annum (if use in the EU is in proportion to global use).

The use pattern of OP is reported to be significantly different from that for NP. Whilst it is known that industry have collected data on the use pattern of OP, these have not been available for the purposes of this study. It should also be noted that OPs are thought not to be the most suitable substitutes for many of the nonylphenol and nonylphenol ethoxylate applications.

It is possible that there may, as is the case with NPs, be certain applications in which it is very difficult to use any substitute (e.g. where it is used as a chemical intermediate, for example). For these applications, therefore, there could be significant economic implications. No further literature has been found on these possible effects.

Table A24.1: Summary Information for Octylphenols	
Regulatory Profile	
Status of regulation	Targeted environmental risk assessment in UK
Production Profile	
Quantities	6,800 tpa
Affected companies	Manufacturers <10 Formulators unknown Users unknown
Value of products	Unknown
Market Profile	
Nature of use and associated quantities	Some applications same as NP but many reported to be different
Employment	Possible adverse effects in similar cases to NP
Substitutes & substitution	Potentially difficult in similar uses to NP
Consumers	Unknown
Use value of products	Unknown

Table A24.2: Assessment of Uncertainty and Socio-Economic Costs for Octylphenols	
Uncertainty	-
Qualitative assessment of socio-economic costs	Unpredictable

A25. PENTACHLOROBENZENE

A25.1 Regulatory Profile

The concentration of pentachlorobenzene in the PPP quintozene is limited to 10 g/kg under Directive 79/117/EEC.

A25.2 Production Profile

Pentachlorobenzene is not produced in the EU.

A25.3 Market Profile

It is used as a chemical intermediate in the production of the fungicide quintozene (pentachloronitrobenzene) and is a technical impurity in that product. It is also an impurity in other products, such as hexachlorobenzene (which itself is not longer produced).

There are at least two producers of quintozene in the EU and several more suppliers. These would be affected by any restrictions on emissions or use of pentachlorobenzene. Emissions of quintozene itself are already restricted to certain applications.

However, quintozene appears only to be authorised for use in the UK, Ireland, France, Spain and Greece (CEC, 2000d).

Economic effects would likely be negligible or moderate if a phase-out were restricted to quintozene but would be greater if applied to products in which pentachlorobenzene is an impurity.

Table A25.1: Summary Information for Pentachlorobenzene	
Regulatory Profile	
Status of regulation	Concentration in quintozene limited under 79/117/EEC
Production Profile	
Quantities	Not produced in the EU
Affected companies	Manufacturers 0 Formulators <10 (production of quintozene) Users <1000 Users will include some SME (farmers)
Value of products	Value of products unknown
Market Profile	
Nature of use and associated quantities	Used as intermediate in production of quintozene (and also emitted as an impurity of quintozene)
Employment	Potential shift in employment if no alternative to quintozene
Substitutes & substitution	Unknown
Consumers	Potential for increased food costs
Use value of products	Depending upon substitutes, has potential implications for human health and also food production Time dependence unknown

Table A25.2: Assessment of Uncertainty and Socio-Economic Costs for Pentachlorobenzene	
Uncertainty	Level of use of quintozene and associated values. Also suitability of alternatives
Qualitative assessment of socio-economic costs	Negligible to moderate (for control of emissions from quintozene)

A26. PENTACHLOROPHENOL

A26.1 Regulatory Profile

Emission limit values and quality standards have been developed for PCP under Directive 76/464/EEC.

Assessment under Directive 91/414/EEC has not yet been completed.

The use of PCP in concentrations over 0.1% has been prohibited through Directive 99/51/EC (amending the marketing and use Directive 76/769/EEC). However, several Member States are permitted to choose not to apply the provision for certain applications (provided that substances and preparations are for use in industrial installations and emission and/or discharge is below quantities prescribed by existing legislation). This derogation applies to France, Ireland, Portugal, Spain and the UK and relates to treatment of wood (except inside buildings and in products for growing purposes that may come into contact with products destined for human consumption), for textiles that are not for clothing or decorative furnishings, and other special exempt cases. However, this derogation only applies until the end of 2008.

However, US pentachlorophenol producers are reportedly in the process of applying for a review of PCP under the new EU Biocides Directive (98/8/EC).

It is covered under Annex 2 to the OSPAR Strategy with regard to hazardous substances (OSPAR, 2000).

A26.2 Production Profile

PCP has not been produced in the EU since 1992. Import values of PCP and its sodium salt are detailed in Table A26.1 (relating to imports from the US, although there may be some imports from other countries).

Table A26.1: Imports of PCP and NaPCP in 1996 and 1999

Substance	1996 (tpa)	1999 (tpa)	Countries
PCP	30	15	UK
NaPCP	378	324	France, Portugal, Spain

A26.3 Market Profile

Of the 30 tonnes of PCP imported into the UK in 1996, this was all converted into 46 tonnes of PCP laurate (PCPL) of which 15 tpa was used in the UK and France and the remainder exported to outside the EU. PCPL is used in the preservation of textiles which are subject to attack by fungi and bacteria (for heavy duty military transport and tent textiles). The main use for NaPCP is in the treatment of wood as a sapstain control agent for freshly cut timber, pallet boards, construction timber and fencing panels (such use is restricted to industrial facilities).

There would potentially be moderate economic effects associated with a requirement for zero-emissions if such a requirement was introduced immediately. However, since use will effectively be banned from the end of 2008, the effect of the WFD would likely be neutral.

BMU (1998) report that a not insignificant potential for emissions occurs through the import of articles containing PCP (such as textiles and leather articles). However, they raise the issue that there is no practical means of controlling the import of products that may contain PCP (which is generally at relatively low levels). Thus, only prohibition on the international level would be sufficient to achieve zero emissions within the EU.

Table A26.1: Summary Information for Pentachlorophenol	
Regulatory Profile	
Status of regulation	Various emission limits and marketing and use restrictions Assessment under 91/414/EEC not yet complete
Production Profile	
Quantities	No production, moderate imports (mainly NaPCP)
Affected companies	Manufacturers 0 Formulators <50 Users <1000
Value of products	Probably few hundred thousand Euros
Market Profile	
Nature of use and associated quantities	Certain wood and textiles
Employment	Probably no shift due to WFD due to ban on use from 2008
Substitutes & substitution	Substitutes probably available in timeframe of 2008
Consumers	Probably no additional effect from WFD
Use value of products	Use on military textiles has potential safety implications Use likely to be phased out by 2008

Table A26.2: Assessment of Uncertainty and Socio-Economic Costs for Pentachlorophenol	
Uncertainty	Values of finished products
Qualitative assessment of socio-economic costs	Moderate but probably negligible over 20 year timetable for WFD

A27. POLYCYCLIC AROMATIC HYDROCARBONS

A27.1 Regulatory Profile

This group of substances includes many single substances of which six have been chosen as indicative parameters under the WFD: benzo(a)pyrene, benzo(b)fluoroanthene, benzo(g,h,i)-perylene, benzo(k)fluoroanthene, fluoroanthene and indeno(1,2,3-cd)pyrene.

Limit values have been introduced for benzo(a)pyrene and total PAH in drinking water (under Directive 98/83/EEC). Under the UN-ECE POPs Protocol, signatories are required to reduce their emissions of four of the six indicative PAHs[5].

There are also limit values for certain PAH in products. For example, Directive 94/60/EC restricts the concentration of benzo(a)pyrene in creosote products to 500 ppm as a maximum and to 50 ppm for certain types of products.

PAHs are included under Annex 2 to the OSPAR Strategy with regard to hazardous substances (OSPAR, 2000).

A27.2 Production Profile and Emission Sources

Polycyclic aromatic hydrocarbons (PAHs) are not generally produced intentionally (although they are present in significant concentrations in certain coal and oil derived products, such as wood preservatives). The following are reported to be the key sources of emission of PAHs into the environment in Western Europe (based upon UBA, 1998):

- motorised traffic;
- use of coal and wood in household heating;
- primary iron and steel production (particularly coke and sinter production);
- non-ferrous metal production (particularly aluminium); and
- wood impregnation and impregnated wood.

In addition, coal fired power stations, industrial boiler firing and open air burning are considered to be important sources on a local level.

A27.3 Market Profile

A total cessation of emissions, discharges and losses would prevent all combustion processes since these all emit PAHs. Activities such as car use, and power generation from fossil fuels would have to cease in order to reduce emissions completely to zero.

In relation to creosote, much expenditure has been incurred in reducing concentrations of benzo(a)pyrene in products (e.g. up to Euro 2 million for individual companies). The

[5] Benzo(a)pyrene, benzo(b)fluoroanthene, benzo(k)fluoroanthene and indeno(1,2,3-cd)pyrene

creosote market is directly worth around 21.9 million Euros with exports of around 7 million Euros. Exports of creosote-treated wood products are also substantial (RPA, 2000c). Thus, it has been possible to reduce emissions, essentially in line with the *de-minimis* principle. However, to reduce concentrations (and thus emissions) to zero would not be possible.

Furthermore, it is estimated that if creosote were to be banned, this could imply cost increases of 220 million Euro per annum simply through the need to replace telephone poles more frequently owing to the substitutes being less efficacious (RPA, 2000c).

The economic implications of cessation of emissions (despite being impossible due to the presence of natural sources) could be immense if this implies the end of the relevant emitting industries - essentially all combustion sources and many food products. They would also be significant for an end to the use of products, such as creosote, that contain PAHs.

Table A27.1: Summary Information for Polycyclic Aromatic Hydrocarbons	
Regulatory Profile	
Status of regulation	POPs. Various concentration limits
Production Profile	
Quantities	None intentionally. Produced as part of e.g. coal tar derivatives and also combustion by-products, etc
Affected companies	Manufacturers 0 Formulators 0 Users 0 If include non-intentional use, will be many companies, including many SMEs
Value of products	None specifically but contained in some products worth many millions of Euro
Market Profile	
Nature of use and associated quantities	None directly. Levels in other products unknown.
Employment	Huge implications if include unintentional sources.
Substitutes & substitution	Alternatives available for some products (e.g. creosote) but often of lower efficacy or greater cost
Consumers	Definite increase in costs if include products containing PAHs such as creosote
Use value of products	Not produced directly

Table A27.2: Assessment of Uncertainty and Socio-Economic Costs for PAHs	
Uncertainty	Concentrations in various products and associated values
Qualitative assessment of socio-economic costs	Extensive

A28. SIMAZINE

A28.1 Regulatory Profile

Assessment of simazine under 91/414 has not yet been completed. It is on the candidate list of substances under Directive 76/464/EEC and no harmonised quality standards or emission limits have thus far been introduced.

A28.2 Production Profile

There is thought to be one EU-based company producing and supplying simazine to the EU market. There is additionally one further company that sells simazine which is imported from the USA. Production is expected to be of the order of 300 tpa (ECPA, 2000c).

A28.3 Market Profile

Sales of simazine in the EU are estimated by industry to be of the order of 550 tpa (ECPA, 2000c).

Like atrazine, simazine is in the triazine group of herbicides which are used largely to control broadleaf weeds. It is used on crops such as corn, fruit (e.g. grapes and citrus) and nuts, as well as in certain non-agricultural applications such as lawns.

Given the relatively small level of use as compared to other herbicides, the cost implications are likely to be of a moderate nature. However, there is a lack of information on the suitability of substitutes which raises uncertainty with that conclusion.

Table A28.1: Summary Information for Simazine	
Regulatory Profile	
Status of regulation	Assessment under 91/414/EEC not yet complete
Production Profile	
Quantities	300 tpa (by one company)
Affected companies	Manufacturers <10 Formulators <10 Users <1000? Users will include some SMEs
Value of products	Probably few million Euro Relatively minor amount in relation to total
Market Profile	
Nature of use and associated quantities	550 tpa. Used in agricultural and non-agricultural weed control
Employment	Unknown effects
Substitutes & substitution	Unknown
Consumers	Potential increase in food costs
Use value of products	Depending upon substitutes, has implications for human health and food production

Table A28.2: Assessment of Uncertainty and Socio-Economic Costs for Simazine	
Uncertainty	Value of products, substitutes
Qualitative assessment of socio-economic costs	Unpredictable (but possibly moderate)

A29. TRIBUTYLTIN COMPOUNDS

A29.1 Regulatory Profile

A ban was introduced on use on vessels under 25 metres and which essentially banned use of 'free association' TBT paints in the early 1990s[6]. This was achieved through Directive 1999/51/EC.

The International Maritime Organisation prohibited the use of all TBT in antifouling systems as being legally binding from 2008 (IMO Resolution A895(21)).

TBT is covered under Annex 2 to the OSPAR Strategy with regard to hazardous substances (OSPAR, 2000).

A29.2 Production Profile

Around 600 to 1,100 tpa were used in antifouling paints in 1992 (RPA, 1992). Other figures for 1980 indicate 3-4,000 tpa were used in wood preservation (which may or may not be a current use) and 2-3,000 tpa in antifouling paints. The level of production in the EU in 1996 was 3,000 tpa, with exports of 1,700 tpa and imports of 30 tpa. Current levels are said to be roughly the same.

A29.3 Market Profile

Consumption in the EU was 1,330 tpa in 1996 and current consumption is understood to be roughly the same. Cost estimates for substitution of TBT include the following:

- an ORTEPA study by Damodaran *et al* (1998) estimates that an international ban on TBT may involve costs of around $1 billion per annum (for paint companies, dry docks/repair yards, ship owners/operators). ORTEPA also quote Milne (1996) who apparently reported that paints reduced fuel usage by $2.5 billion globally;

- in a study by WS Atkins for DG III (1998), costs were estimated as 100m ECU for TBT producers with 3-4 plant closures and the possible loss of 450 jobs; and

- RPA (1992) estimated discounted costs for a total EU ban on anti-fouling paints in terms of paint costs, dry dock costs, lost plant utilisation and fuel costs. These were estimated as being around 1.4 billion Euros over a five year period or 2.3 billion Euros over a ten year period (converted to 2000 Euros from 1992 Sterling).

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6 Self Polishing Copolymer (SPC) TBT paints have been widely used for some time and are now used on 70% of the world fleet is protected with TBT SPC. The level of emission from these is reported to be significantly less than for free association paints.

These are all significant costs but the implications of the WFD could essentially be considered neutral due to the IMO Resolution which will end use by 2008.

In terms of substitutes, an OSPAR DIFF report (1999 - not seen) apparently reports that Irgarol, Diuaron and Sea-Nine 211 (potential substitutes) may have unwanted environmental effects. This has not been further investigated. Whilst some substitutes may have lesser (but not insignificant) environmental effects, there may often by a compromise in terms of efficacy (RPA, 1992).

Table A29.1: Summary Information for Tributyltin	
Regulatory Profile	
Status of regulation	To be banned globally by 2008
Production Profile	
Quantities	3,000 tpa produced
Affected companies	Manufacturers <10 Formulators unknown Users >1000 Users include many SMEs
Value of products	Unknown
Market Profile	
Nature of use and associated quantities	1,330 tpa used in the EU as anti-fouling product on boats
Employment	No distributional effects if banned globally but loss of exports if banned immediately
Substitutes & substitution	Unknown but potentially have poor efficacy and possibly also harmful to the environment. However, no effects directly related to WFD
Consumers	No cost increase related to WFD
Use value of products	No additional detriment expected from WFD

Table A29.2: Assessment of Uncertainty and Socio-Economic Costs for Tributyltin	
Uncertainty	-
Qualitative assessment of socio-economic costs	Negligible

A30. TRICHLOROBENZENES

A30.1 Regulatory Profile

Risk assessment under Regulation EEC No. 793/93 has not yet been completed (Denmark is the rapporteur). Trichlorobenzene is also covered under Directive 1999/13/EC on volatile organic compounds (VOCs). Emission limit values and quality standards have been developed under Directive 86/280/EEC.

Trichlorobenzenes are covered under Annex 2 to the OSPAR Strategy with regard to hazardous substances (OSPAR, 2000).

A30.2 Production Profile

1,2,4-trichlorobenzene (1,2,4-TCB) is the indicative substance specified in the proposed list of PS. There were two manufacturers of this substance in the EU which produced 7,000 tpa in 1994/95. A third manufacturer started production in 1997/98, with a production of around 3,000 tpa (reducing production from the other two slightly). 80% of the production is exported outside the EU.

A30.3 Market Profile

Due to the high level of exports, only 1,400 tpa were used in the EU in 1994/95. It is used mainly as a chemical intermediate, particularly for certain herbicides, pigments and dyes (1,100 tpa) and as a process solvent (200 tpa). It was reportedly used in the past as a dyestuff carrier, lubricant and additive (100 tpa in 1994/95). It is also reportedly used in certain pharmaceuticals.

Since that time, the two initial EU manufacturers have reportedly stopped selling 1,2,4-TCB for use in open applications. Use as a dyestuff carrier has also been voluntarily phased out.

Table A30.1: Summary Information for Trichlorobenzenes	
Regulatory Profile	
Status of regulation	ESR risk assessment incomplete. Emission limits in place
Production Profile	
Quantities	7,000 tpa in 1994/95
Affected companies	Manufacturers <10 Formulators <50 Users unknown
Value of products	Unknown
Market Profile	
Nature of use and associated quantities	1994/95 use was 1,400 tpa used as chemical intermediate (1,100 tpa), process solvent (200 tpa) and dyestuff carrier, lubricant and additive (100 tpa)
Employment	Shift to outside EU due to high level of exports
Substitutes & substitution	Substitutes available for textiles and probably solvent. Not investigated yet for use as chemical intermediate
Consumers	Potential increase in costs but uncertain magnitude
Use value of products	Pharmaceuticals potentially health-critical and may continue to be in future

Table A30.2: Assessment of Uncertainty and Socio-Economic Costs for Trichlorobenzenes	
Uncertainty	Costs and specific applications
Qualitative assessment of socio-economic costs	Unpredictable

A31. TRICHLOROMETHANE (CHLOROFORM)

A31.1 Regulatory Profile

Under Regulation EEC No 793/93, France is rapporteur for chloroform. The relevant risk assessment has not yet been completed. The competent authority has been contacted in this regard although no information has yet been received.

Environmental quality standards and limit values have been developed under Directive 76/464/EEC through Directive 88/347/EEC, amending Directive 86/280/EEC.

It is classified as a VOC under Directive 1999/13/EC and a limit value for trihalomethanes has been developed under Directive 98/83/EC (the Drinking Water Directive).

A31.2 Production Profile

Chloroform is produced in six Member States (Netherlands, France, Germany, Italy, Spain and the UK). Total production capacity is reported to be around 316,000 tpa, with a current business of 240 mEUR.

There are 41 producers or suppliers reported in the Chemicals and Companies database. Some of these are relatively small companies whereas others are very large with a widespread international presence. For some, chloroform will form a relatively small proportion of turnover, whereas for others it will be highly significant.

Based on sales figures and exports of 50,000 tpa, it is estimated that imports account for around 16,000 tpa. Note that the export value of chloroform for the EU probably amounts to nearly 40 mEUR per annum.

A31.3 Market Profile

Under the IUCLID Database, chloroform is classified as a 'central nervous system preparation' and uses are specified in the pharmaceuticals, prosthetics, and medicinal chemistry sectors, as well as bulk organic chemicals and petrochemicals.

95% of sales are reported to be for the manufacture of other chemicals, particularly HCFC-22[7]. This is then used in the production of fluorinated polymers and copolymers. Industry report that there is no alternative technology available. HCFC-22 is also used in the manufacture of dyestuffs, pharmaceuticals and pesticides.

Other applications for chloroform include use as a solvent (in extraction of penicillin and other antibiotics), paints, pyrethroid pesticides, fats, oils, rubbers, alkaloids and

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7 $CHClF_2$, which has been used to replace CFC-11 ($CFCl_3$) as a blowing agent and refrigerant due to its much lower ozone depletion potential.

waxes. Industry also reports that there are no alternatives for use in the pharmaceutical and agrochemical industries.

Total downstream value of chloroform is estimated by industry to be worth 800 to 1,600 mEUR annually, with 600 related jobs. There are also significant social impacts associated with certain uses, such as pharmaceuticals.

Table A31.1: Summary Information for Trichloromethane	
Regulatory Profile	
Status of regulation	Risk assessment under Regulation 793/93 incomplete. Various emission limits/quality standards
Production Profile	
Quantities	316,000 tpa
Affected companies	Manufacturers <50 Formulators >50 Users >1000 Users include many SMEs
Value of products	Direct value of 240 mEUR (probably significant proportion of turnover for many)
Market Profile	
Nature of use and associated quantities	Mainly as chemical intermediate
Employment	Definite shift in activity from EU (loss of exports and ability to make certain products in which is an intermediate)
Substitutes & substitution	Probably possible for e.g. use as solvent Industry report no alternatives for some pharmaceuticals and agricultural use
Consumers	Probable increase in costs and loss of some products
Use value of products	Critical applications include pharmaceuticals

Table A31.2: Assessment of Uncertainty and Socio-Economic Costs for Trichloromethane	
Uncertainty	Values of downstream products, suitability of substitutes
Qualitative assessment of socio-economic costs	Extensive

A32. TRIFLURALIN

A32.1 Regulatory Profile

Trifluralin is on the 'candidate list' of substances under Directive 76/464/EEC and, as such, Community-wide emission limits or quality standards have not yet been developed.

Assessment under Directive 91/414/EEC has not yet been completed.

A32.2 Production Profile

Trifluralin is manufactured at one key EU site in Italy and is formulated and packed at several others. Six EU-based suppliers are reported in the Chemicals and Companies Database (RSC, 1998).

The above facilities are reported by industry to form part of a global supply chain. A phase-out in the EU would be likely to lead to a loss of exports and thus EU employment.

A32.3 Market Profile

Trifluralin is reported to be authorised for use in all Member States except Sweden, Denmark and the Netherlands (CEC, 2000d). It is one of the major herbicides and is used to control annual grasses and many broad-leaved weeds in a wide range of fodder, cereal, vegetable, oilseed and soft fruit crops including a range of minor uses that are important to the horticultural industry. It is reported by industry to provide inexpensive weed control in crops which have low profit margins.

It is reported that the key applications for trifluralin are sunflowers and oilseed rape (OSR). In France it is used on over half of the areas growing these crops (400,000 ha and 700,000 ha respectively). It is also used widely in fodder peas, small grains and various vegetable and fruit crops.

An estimated 3,200 tonnes were applied in Europe in 1999 (including non-EU countries). The level of use is reported to be reasonably static (Dow AgroSciences, 2000a).

Possible alternatives include cyanazine[8], carbetamide, propyzamide. There are possibly higher environmental impacts with some of these substitutes[9].

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8 For some crops (e.g. oilseed rape), the cost of applying cyanazine would appear to be generally less than that of trifluralin. However, the alternatives are not always applicable for the same crops and may be less effective across the board.

9 E.g. see MAFF (1999).

Industry report that the key problem with finding alternative herbicides are with the two key applications: sunflowers and oilseed rape. The main problem is in terms of finding a broad leaf herbicide suitable for post-emergence use, for which industry report that there are few alternatives for oilseed rape and none for sunflowers.

Table A32.1: Summary Information for Trifluralin	
Regulatory Profile	
Status of regulation	Assessment under 91/414/EEC not yet complete
Production Profile	
Quantities	Few thousand tpa
Affected companies	Manufacturers <10 Formulators <10 Users >1000? Users will include many SMEs
Value of products	Unknown
Market Profile	
Nature of use and associated quantities	3,200 tpa as herbicide in oilseed rape and sunflower especially
Employment	Probable shift away from EU
Substitutes & substitution	Highlighted problems with substitutes for oilseed rape and sunflower
Consumers	Probable increase in costs for consumers
Use value of products	Implications for crop production Time dependence unknown

Table A32.2: Assessment of Uncertainty and Socio-Economic Costs for Trifluralin	
Uncertainty	Value of products. Details of tested substitutes
Qualitative assessment of socio-economic costs.	Unpredictable

ANNEX B

GLOSSARY OF ACRONYMS

ANNEX B: GLOSSARY OF ACRONYMS

ABS	Acrylonitrile-Butadiene-Styrene (Copolymers)
BDPE	Brominated Diphenyl Ether (e.g. penta-BDPE)
COMMPS	Combined Monitoring-based and Modelling-based Priority Setting
CP	Chlorinated Paraffin
DCM	Dichloromethane
DDT	Dichlorodiphenyltrichloroethane
ECB	European Chemicals Bureau
EDC	Ethylene Dichloride
ELV	Emission Limit Value
EQS	Environmental Quality Standard
EU	European Union
EVA	Ethylene Vinyl Acetate
HCB	Hexachlorobenzene
HCBD	Hexachlorobutadiene
HCH	Hexachlorocyclohexane
HIPS	High Impact Polystyrene
IMO	International Maritime Organisation
IUCLID	International Uniform Chemical Information Database
kt	Kilotonnes
MAFF	Ministry of Agriculture, Fisheries and Food (UK)
NiCd	Nickel Cadmium (batteries)
NiMH	Nickel Metal Hydride (batteries)
NP	Nonylphenol
NPE	Nonylphenol Ethoxylate
OECD	Organisation for Economic Cooperation and Development
OP	Octylphenol
OP	Organophosphate
ORTEPA	Organotin Environmental Programme Association
OSPAR	Oslo and Paris (Commission/Convention)
OSR	Oilseed Rape
PAH	Polycyclic Aromatic Hydrocarbon
PBT	Persistent, Bioaccumulative and Toxic (substances)
PBT	Polybutylene Terephthalate
PC	Polycarbonate
PET	Polyethylene Terephthalate
PHS	Priority Hazardous Substance
POPs	Persistent Organic Pollutants
PP	Polypropylene
PPP	Plant Protection Product
PS	Polystyrene
PUR	Polyurethane
PVC	Polyvinyl Chloride
RPA	Risk & Policy Analysts Ltd.
SBR	Styrene Butadiene Rubber
SCCP	Short Chain Chlorinated Paraffin

SMEs	Small and Medium Sized Enterprises
SPC	Self-Polishing Copolymer
TBT	Tributyltin
TCB	Trichlorobenzene
tpa	Tonnes per annum
UNECE	United Nations Economic Committee for Europe
UNEP	United Nations Environment Programme
UPE	Unsaturated Polyester Resin
VCM	Vinyl Chloride Monomer
VOC	Volatile Organic Compound
WEEE	Waste Electronic and Electrical Equipment
WFD	Water Framework Directive

ANNEX C

RELEVANT EXISTING LEGISLATION AND CONVENTIONS

ANNEX C: RELEVANT EXISTING LEGISLATION AND CONVENTIONS

C1. INTRODUCTION

This Annex provides a brief background to some of the key legislation and conventions which have an impact upon the introduction of a ban on substances under the Water Framework Directive. These include the following:

- Directive 76/464/EEC on pollution caused by dangerous substances discharged into the aquatic environment;
- Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations;
- Directive 91/414/EEC concerning the placing of plant protection products on the market;
- Regulation EEC No. 793/93 on the evaluation and control of the risks of existing substances;
- Directive 91/157/EEC relating to the treatment and disposal of batteries and accumulators containing certain dangerous substances (mercury, cadmium and lead); and
- initiatives developed under the OSPAR Convention.

The discussion is intended to provide a background to the 'regulatory profile' sections of the assessment of individual substances in Annex A. Within those sections, certain other pieces of legislation are mentioned that are not discussed within this annex since they are of less relevance to the implications for identification (and later management) of PHSs.

C2. THE DANGEROUS SUBSTANCES DIRECTIVE

Prior to agreement of the WFD, Directive 76/764/EEC[1] set the principal emissions control policy for discharge of dangerous substances to the aquatic environment. The aim of the Directive was to *eliminate* water pollution by substances in the families and groups of substances in List I of the Annex to that Directive. For those substances in List II, there was a requirement to *reduce* pollution. In 1982, 132 substances were identified as potential candidates for inclusion in List I.

The means to eliminate pollution from List I substances is through the introduction of limits on the emissions of those substances to water (emission limit values, ELVs) and specified concentrations in the environment (environmental quality standards, EQSs) through 'Daughter Directives'. However, these were only introduced for 18 of the 132 substances. For the remainder, Member States were allowed to choose the appropriate means of control (ELVs or EQSs) since they were treated as List II substances.

Under the WFD, all of the Daughter Directives introduced are to be reviewed within two years.

[1] OJ L 129, 18.5.1976, p. 23.

C3. THE MARKETING AND USE DIRECTIVE

According to Directive 76/769/EEC[2], Member States are required to take all necessary measures to ensure that the certain dangerous substances and preparations may only be placed on the market or used subject to certain specified conditions.

This is a very flexible piece of legislation, allowing for the prohibition of specific uses of dangerous substances, specification of conditions for their use or phasing-in of restrictions. Derogations for various uses can also be specified (e.g. on the basis of disproportionate costs).

Restrictions have been introduced on the marketing and use of several of the substances considered within this report. Some of these restrictions relate to their associated environmental risks whilst other restrictions relate to various other concerns.

C4. THE PLANT PROTECTION PRODUCTS DIRECTIVE

Directive 91/414/EEC[3] is intended to harmonise arrangements for authorisation of PPPs in the EU through harmonising the process for considering the safety of active substances. Product authorisations, however, remain the responsibility of the Member States.

Under the Directive a positive list (Annex I to the Directive) is established, containing the active substances that have been shown not to pose an unacceptable risk to human health or the environment.

A variety of the substances considered for the purposes of this study (the PS) are currently under review under this process.

C5. THE EXISTING SUBSTANCES REGULATION

Council Regulation (EEC) No. 793/93 requires that the actual or potential risks for human health and the environment from priority substances (established in Regulations subsequent to 793/93) be assessed using principles laid down in Commission Regulation No. 1488/94 and further Technical Guidance.

Conclusion of unacceptable risks to the environment under this system has been the principal mechanism for the introduction of risk reduction measures (following the preparation of risk reduction strategies).

[2] OJ L 262, 27.09.1976, p. 21.

[3] OJ L 230, 19.8.1991, p. 1.

Several of the PSs are covered by the Regulation and several risk assessments have either been completed or are in preparation. Following these assessments, a number of risk reduction strategies to address the risks associated with those specific uses of substances that are identified as presenting unacceptable risks (rather than for the substances *per se*).

C6. BATTERIES

Directive 91/157/EEC[4] is relevant to three of the substances considered within the scope of this study (cadmium, mercury and lead). It establishes the following key provisions:

- the marketing of certain batteries and accumulators is prohibited due to the quantities of dangerous substances they contain;
- recovery and controlled disposal of spent batteries and accumulators (Member States must ensure that they are marked and collected separately); and
- Member States should take appropriate measures to deal with the environmental hazard posed by disposal of appliances containing non-removable batteries or accumulators.

C7. OSPAR

A commonly encountered provision in relation to the substances considered for this study is inclusion of a substance in Annex 2 to the OSPAR Commission's Strategy with regard to Hazardous Substances. The objective of this Strategy is to prevent pollution of the North East Atlantic by continuously reducing discharges, emissions and losses of hazardous substances (as defined in Annex 1 to the Strategy), with the ultimate aim of achieving concentrations in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances.

A number of the PS are included in Annex 1 to the Strategy (OSPAR, 2000). There is a distinct relationship between some of the wording of the WFD in that Article 16 (3) of the WFD requires the identification of PHS and Article 16 (6) requires measures for cessation or phase-out of discharges, emissions and losses within 20 years. Thus, where a substance is identified as a PHS, similar objectives to the OSPAR Strategy will apply[5]. However, this does not imply that the objectives of the Strategy for all of the Chemicals for Priority Action are implemented in Community law. Indeed, a number of Member States are not party to OSPAR.

[4] OJ L 078, 26.03.1991, p. 38.

[5] Identifying the appropriate cost-effective and proportionate level and combination of product and process controls for both point and diffuse sources and taking account of Community-wide uniform emission limit values for process controls.

Further, the legal status of the Strategy is of a political, non-binding nature and no Decisions or Recommendations have been adopted as a direct result of the Strategy.

However, in relation to one of the PS, signatories to Decision 95/1 have agreed to phase-out the major uses of SCCPs by 2004. This is the only firm commitment under OSPAR to phase-out the use of any of the PS. Again, however, this Decision does not apply to all Member States (only those that are party to OSPAR). Furthermore, although the UK is a party to OSPAR, it has not accepted Decision 95/1.