Assessment of the Impact of the New Chemicals Policy on Occupational Health

Final Report

prepared for European Commission
Environment Directorate-General

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ASSESSMENT OF THE IMPACT OF THE NEW CHEMICALS POLICY ON OCCUPATIONAL HEALTH

Final Report – March 2003

prepared for

European Commission – Environment Directorate-General

by

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EXECUTIVE SUMMARY

1. Aims and Approach

Previous work on the implications of the New Chemicals Policy has focused on the direct, and to a lesser degree, indirect impacts to businesses of implementing REACH. The environmental and worker health and safety benefits that may arise from the implementation of REACH were not considered.

The aim of this study as been to provide an assessment of the potential reduction in occupational health impacts that may arise at the EU level from the implementation of REACH. This includes consideration of impacts on both workers within the chemical industry and downstream users of chemicals. A separate study has been contracted by the Commission to prepare wider assessments of the potential environmental and public health benefits of implementing REACH.

The approach that has been taken in assessing the potential health risk reductions has involved:

- examining the degree to which REACH may lead to further reductions in occupational health related diseases given the existing legislative framework;
- reviewing existing data on the numbers of cases of chemical exposure-related occupational health impacts at the Member State and EU level, and determining the number attributable to non-specific and unknown chemicals;
- reviewing the literature on the financial and economic costs of ill-health;
- developing scenarios to estimate the number of future health impacts avoided;
- setting out assumptions as to the timing of health impact reductions following implementation of REACH; and
- calculating the economic value of the future health impacts avoided.

The study has not included an extensive consultation exercise or detailed survey and discussions with occupational health experts in different industry sectors or Member States. Instead, owing to both time and budget restrictions, we have relied upon readily available data produced by Member State Health and Safety Bodies, Eurostat, Trade Organisations and Labour Organisations. These data have been added to by a range of government and academic sources.

2. Expected Role of REACH in Reducing Occupational Illnesses

There is a wide array of legislation providing protection to workers against the occupational diseases that may arise from exposure to chemicals. Much of this has been introduced in the past few years and is expressly aimed at reducing occupational health impacts. However, because some of this legislation is yet to come into full force, the impact that it will have on the number of cases of different health impacts arising across the European Union workforce is unclear. This is particularly true for occupational cancers arising from exposures to chemicals. The impact that the recent Directives will have on future rates of occupational exposure related cancer has not been quantified. As a result, there is uncertainty surrounding the number of

occupational cancers that will be reduced as a result of these recently introduced Directives.

In addition, for health end-points such as cancer, there may be more than one causal factor leading to the development of the disease; thus, exposure to chemicals may be the main factor leading the development of cancer, or may be a contributing factor together with other environmental and socio-economic factors. This leads to uncertainties as to the number of cancers (and other diseases) that may be reduced through the targeting of chemical agents known to be leading to a particular disease and those not currently known to owing to their being less information available on their properties.

A key factor affecting the ability of the current worker safety legislation to deliver the desired reduction in health impacts, however, is that the legislation relies on the availability of data on human health risks for its effectiveness. Where such data are not available for chemicals being used in the workplace, the ability of the legislation to achieve its goals is limited. Given that the necessary data are unavailable for most chemicals currently placed on the market or used as intermediates, the effectiveness of many of the Directives is currently being restricted.

In the White Paper Strategy for a Future Chemicals Policy (Com (2001) 88 final), the provision of new and additional data on the health risks arising from chemicals whose properties are currently poorly understood was predicted to result in the identification of 500 new carcinogenic, mutagenic and reproductive toxic (CMR) substances. Under REACH, the continued use of these substances would have to be authorised, with socio-economic justifications provided for use in specific applications. The result of the identification and authorisation of these currently unknown CMRs is assumed to be a reduction in the incidence of work-related cancers in the future, with corresponding reductions not only the number of deaths arising from cancer, but also the financial and economic costs associated with cancer treatment and recovery.

3. Health Impact Scenarios

The analysis carried out here has focused on assessing future health impact reductions for the following occupational health end-points:

- skin diseases;
- respiratory diseases;
- eye disorders;
- central nervous system diseases; and
- cancer (covering 16 different types of cancer deaths).

For each of these end-points, estimates were developed of the number of cases that may be avoided in the future owing to the increased availability of information on health risks and to the authorisation of currently unknown CMRs. Statistical data on occupational diseases in general were used to identify the following sets of chemicals related diseases:

- the total number of diseases caused by exposure to chemicals;

- the number of diseases caused by exposure to specific chemicals (such as isocyanates);
- the number of diseases classified as being caused by exposure to 'non-specific' chemicals; and
- the number of diseases classified as being caused by exposure to 'unknown' chemicals.

Through extrapolation of country data, estimates were developed on the number of cases of diseases for the various end-points caused by exposure to non-specific or unknown chemicals. Table 1 summarises the scenarios that act as the basis for the assessment. The lower bound figures relate to exposure to unknown chemicals while the upper bound relates to exposure to non-specific chemicals.

The exception to this approach is for cancers, where mortality data for men and women for 16 different end-points were combined with estimates of the percentage of cancer deaths for each of those end-points to result from occupational exposure to chemicals. From a total figure for chemicals exposure related occupational cancer deaths per year in the EU, an estimate of 20% of these was adopted as resulting from exposure to unknown chemical carcinogens. It was then assumed that one third and two thirds of these deaths per year would be avoided in the future, to provide the lower and upper bound scenarios.

More generally, these two scenarios reflect the uncertainty surrounding the actual impact that additional information provision and authorisation under REACH will have on chemicals related occupational diseases.

Table 1: Occupational Disease Impact Scenarios on the Number of Cases Reduced Under REACH

Health End-Point	Cases Associated with Exposure to Unknown Chemicals – LOWER BOUND	Cases Associated with Exposure to Non-Specific Chemicals - UPPER BOUND
Skin Diseases	**1,350**	**12,000**
Respiratory Diseases	**275**	**3,680**
Eye Disorders	**50**	**50**
CNS Diseases	**50**	**485**
Cancers	**2,167**	**4,333**

4. Economic Costs

The above figures were then combined with estimates of the economic costs associated with diseases under each of the end-points, where these costs include:

- costs of medical treatment;
- the value of lost output;
- human costs, where these reflect an individual's willingness to pay to avoid a particular health effect.

In the case of cancer, lower and upper bound valuations were adopted, with both of these being based on recommended figures for the value of preventing a fatality in

cost-benefit analyses carried out for or by DG Environment. Both the lower and upper bound figure represent individuals' willingness to pay to avoid the risk of death (with this being the value of a statistical life). Both the lower and upper bound estimates have been adjusted to reflect the age of those at risk and the fact that there is a period of ill health prior to death associated with cancer (a cancer premium). These adjustments have been made following the recommendations set out in DG Environment's guidance on how to apply such values.

The figures presented in Table 2 were adopted as the costs arising from the types of diseases falling under each of the end-points.

Table 2: Cost Assumptions Used in this Assessment (€2000)

End-Point	**Medical Costs (per case)**	**Lost Output (per day)**	**Human Costs (per day)**	**Days per Case**	**Total per Case per Year (€)** (rounded)
Skin Diseases	€94	€64	€14	7	€640
Respiratory Disease	€170 per year	€64	€80	7	€1,180
Eye Disorders	€35	€64	€17	7	€600
CNS Diseases	€4375	€64	€450	14	€11,570
Cancer (Deaths only)			€1.39 million (lower) €2.14 million (upper)	n/a	€1.39 million (lower) €2.14 million (upper)

5. The Results

The results of the analysis are presented in Table 3. The figures presented here assume that the benefits are realised over a 30 year time period, with the time when reductions in diseases begins to occur linked to the nature of the end-point. The number of cases avoided in a given year (over the 30 year time period) also varies across end-points, with the number of cases avoided accumulating over time. Note that a 3% discount rate has been assumed for consistency with the Business Impact Assessment carried out for REACH (RPA and Statistics Sweden, 2002).

Table 3: Discounted Value of Health Impact Reductions (€1 million, 2000 prices, discounted over 30 years at 3%)

End-Point	**Value for Lower Bound Number of Cases**	**Value for Upper Bound Number of Cases**
Skin Disease	11.6	102.9
Respiratory Disease	4.0	53.5
Eye Disorders	0.4	0.4
CNS Diseases	7.1	68.8
Cancer Deaths (using low VOSL value)	17,591.6	35,183.1
Cancer Deaths (using best VOSL value)	27,083.4	54,166.8
Total Excluding Cancer	23	225
Total Including Cancer (low VOSL)	17,615	35,408
Total Including Cancer (best VOSL)	27,106	54,392
Note: Rounding may affect column sums		

As can be seen from Table 3, the present value of the estimated health impact reductions arising from REACH range from around €18 billion to €27 billion for the lower bound assumptions on the number of cases that will be reduced through increased test data and authorisation. The present value figure of almost €18 billion relates to the lower figure for the value of a statistical life assumed for cancer deaths. The higher figure of €27 billion relates to the 'best estimate' VOSL adjusted as recommended by the Commission.

The above estimates assume that number of cases of diseases for the non-cancer end-points related to unspecific or unknown chemicals is effectively reduced to zero. This is over-optimistic as cases of disease will continue, albeit one would expect incidence rates to reduce significantly (and in some cases they should fall close to zero once action has been taken in the workplace to reduce exposure). This will be off-set, however, by the fact that not all of the economic costs have been taken into account.

For the cancer end-points, the figures adopted here as to the predicted number of cases of cancer that would be reduced is more pessimistic. For the lower bound figure, we have assumed that only 0.23% of total annual cancers deaths in the EU are associated with exposure to unknown chemical carcinogens in the workplace and, thus, could potentially be avoided as a result of more data being available on chemical properties through REACH. In addition, the estimates of costs avoided for cancer relate only to individuals' willingness to pay to avoid the risk of death. They take no account of the medical costs associated with the diagnosis and treatment of the cancers prior to death. Nor do the above estimates take into account the human costs associated with those who develop but survive a case of cancer.

The estimated benefits of avoiding future cancer deaths are much greater than those associated with the avoidance of the other end-points. This does not mean, however, that the benefits of reducing these other diseases would not be significant. In particular, for the upper bound number of cases, the estimated value of reducing the number of occupational skin diseases is over €100 million and the value of reduced respiratory disease is over €53 million.

There is obviously uncertainty surrounding these estimates. This includes uncertainty as to the actual number of cases for each of the diseases that will be reduced as a result of REACH and the economic value of those reductions. Furthermore, not all of the economic costs associated with occupational diseases have been accounted for within the above estimates. This is particularly true in the case of cancer, as the costs incurred in relation to survival of a case of cancer are not taken into account (where these would include medical costs, lost output and human costs).

6. Conclusions

The economic value of the health impact reductions that may arise from REACH are significant. This is true whether one adopts the lower or upper bound scenarios as to the number of future cases of occupational diseases avoided and as to the economic value of avoiding those diseases. Although the estimates vary widely depending on

what set of assumptions are adopted, all of the estimates point to considerable future savings in health care costs, lost output and 'human' costs.

It should also be noted that the above figures may represent underestimates of the full economic value of reductions in occupational health. In particular, the approach adopted in producing the above figures does not take into account the following resource and social costs:

- the costs to employers associated with reduced productivity of those suffering from chronic illnesses;
- administrative, management and legal costs incurred by employers;
- loss of expertise and experience, where workers suffer disablement;
- the direct costs to workers of purchasing medicines (with the exception of asthma) or of traveling to visit doctors/hospitals; and
- Government expenditure on sick pay and disability benefits and the administration of these schemes.

Offsetting these further benefits, however, is the fact that REACH alone will not deliver the reductions in health impacts. Achieving these benefits will require that actions are taken by the European Commission and Competent Authorities, as well as by manufacturers, downstream users and consumers of chemicals. This report does not address the costs of undertaking such measures, where these may include additional controls, chemical substitution, changes in processing methods, etc. Thus, the full costs of delivering the economic benefits calculated above are greater than those of implementing REACH alone.

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1. INTRODUCTION

1.1 Background to the Study

In February 2001, the European Commission adopted a White Paper (COM(2001) 88 final) setting out its strategy for a future Community Policy for Chemicals. The aim of this strategy is to ensure a high level of protection for human health and the environment, while ensuring the efficient functioning of the internal market, and stimulating innovation and competitiveness in the chemical industry.

The White Paper (CEC, 2001) proposes that, in the future, new and existing substances are regulated under the same procedures and within a single system. The current system for regulating new substances should be revised and made more effective and efficient, with the revised obligations being extended to existing substances. This revised system is called REACH, which stands for the **R**egistration, **E**valuation and **A**uthorisation of **CH**emicals. The requirements of the proposed REACH system depend on the proven or suspected hazardous properties, uses and exposure and volumes of chemicals produced and/or imported into the European Union (EU).

Earlier this year, work was completed on the first phase of the Assessment of the Business Impacts of the New Chemicals Policy (RPA and Statistics Sweden, 2002). The intention of this work was to identify cost-effective mechanisms for implementing REACH. In so doing, the assessment produced a series of estimates of the potential compliance costs to industry of introducing REACH under a number of different scenarios. The focus of the study was on the direct and, to a lesser degree, indirect costs to the chemicals industry and its downstream users. The environmental, general public health and worker health and safety benefits that may arise from the implementation of REACH were not considered.

Although the benefits of the proposed Policy are generally acknowledged and accepted, the Commission is interested in gathering further information on the potential impacts of REACH on occupational health. For example, it has been suggested that the REACH has the potential to realise a range of benefits associated with the provision of additional test and risk assessment data on chemicals, which would then lead to improved classification and labelling and earlier restrictions on substances of concern.

1.2 Aims and Scope of the Study

The Commission is now interested in gathering further information on the potential benefits arising from the New Chemicals Policy. With this in mind, RPA has been commissioned to undertake a limited piece of research aimed at providing a general indication of the potential occupational health impacts arising at the EU level from the implementation of REACH. This includes consideration of impacts on:

- the health and safety of workers within the chemical industry;
- the health and safety of workers handling chemicals in other industries, including warehousing; and
- to the extent possible, the health and safety of consumers using chemicals.

1.3 Approach to the Study

The study has required the development of predictions on the potential number of occupational health cases that may be avoided through the implementation of REACH. This in turn has had to take into account the fact that there is a wide array of legislation providing protection to workers against the occupational diseases that may arise from exposure to chemicals. Much of this legislation has been introduced in the past few years and some is yet to come into full force. The impact that it will have on the number of cases of different health impacts arising across the European Union workforce is as yet unclear.

In addition, for some occupational diseases (such as cancer), there may be more than one causal factor leading to the development of the disease. Thus, exposure to chemicals may be the main factor leading the disease, or may be a contributing factor together with other environmental and socio-economic factors. This leads to uncertainties as to the number of cases that may be reduced through the targeting of chemical agents currently known to be leading to a particular disease and those not currently known to do so, owing to there being less information available on their properties.

The above factors have been taken into account to the degree possible in developing predictions on the potential number of occupational disease cases avoided. These predictions have then been combined with readily available economic valuation data to calculate the economic value of avoiding such cases in the future.

The approach adopted in carrying out the above has been as follows:

1) Identification and review of existing published data on the numbers of cases of chemicals -related occupational disease at the Member State and EU level.

2) Review of literature on the financial and economic costs of ill-health.

3) Development of scenarios for the health impacts avoided, with these adopting varying assumptions with regard to REACH and its impacts.
4) Scenario analysis and benefits assessment.

It is important to note that this study has not included an extensive consultation exercise, nor has it involved the collection of sector specific occupational health data nor surveys of workers or occupational health practitioners in the field. Instead, the study has drawn upon available published data produced by Member State Health and Safety Bodies, Eurostat, Trade Organisations and Labour Organisations. These data have been collated and are used together with a range of academic sources to provide the basis for the assessment. Thus, although we have been as systematic as possible

given the resources and time available, a detailed review of the health literature has not been possible. As a result, the findings should be considered to be indicative of the potential occupational health benefits that may arise from REACH.

1.4 Organisation of this Report

This document is the Final Report on the study, and has been organised as follows:

- Section 2 provides an overview of the key pieces of existing occupational health and safety legislation relevant to chemical exposure, as this provides the baseline for considering what impacts may arise from the New Chemicals Policy;
- Section 3 presents a summary of the types of health data that have been collected, issues associated with the use of these data, and the health impact scenarios providing the basis for assessing the potential reductions in illness arising from REACH;
- Section 4 discusses the valuation of changes in health impacts and presents the economic values used in the assessment;
- Section 5 presents the results of the assessment for each of the health impact scenarios; while
- Section 6 sets out our conclusions.

2. IMPACTS OF EXISTING HEALTH AND SAFETY LEGISLATION

2.1 Introduction

In order to determine the baseline against which changes in occupational health due to the implementation of the New Chemicals Policy may occur, it is important to understand the current status of regulation on occupational health and safety in the EU.

Workers who produce or handle chemical substances are not necessarily exposed to chemicals in a way that leads to the uptake of a substance into the body, which is a prerequisite for the development of any substance-related health effect. Legislation has increasingly required the use of measures of exposure control such as closed systems, ventilation and exhaust equipment, and personal protective equipment to minimise the potential for contact with hazardous substances. Historical exposure data, where available, demonstrate a reduction over recent decades[1] in exposure leading to the uptake of chemical substances.

In addition to regulations that are in place, the impact of which may already be reflected in occupational health statistics, a number of new measures have been adopted in recent years that have not yet been fully implemented. These measures can be expected to lead to significant further reductions in health effects associated with occupational exposure to chemicals. To achieve the desired reductions, however, it is essential that the properties of chemicals are known. This will be the key contribution of REACH to the more effective implementation of the new occupational health legislation. This does not mean that further reductions in occupational health cases would not be realised in the absence of REACH, only that REACH may help realise such benefits sooner and is likely to identify additional chemicals posing health risks to workers.

The above is particularly true with regard to workplace exposure to carcinogens. Recently introduced legislation (Directive 99/38/EC – see Section 2.5) should have an impact on the number of future cancers stemming from occupational exposure to chemicals. The effect of REACH will be to add to this reduction. However, because the legislation is not yet fully in effect and there is latency between exposure and cancer developing (e.g. 10 to 20 years delay), it is difficult to predict what reduction in cancers can be attributed to current legislation and, thus, what further role REACH could play in reducing cancers.

The following paragraphs provide an overview of current EU-wide legislation on occupational health and safety, with particular reference to exposure to chemical agents at the workplace. A discussion is then provided on how REACH will relate to the implementation of this legislation and what further role it will have in reducing chemical risks.

[1] See, for example, Jensen *et al*. 1990, Goldberg & Hémon 1993, Glass *et al*. 1994

2.2 Directives 67/548/EEC and 1999/45/EC – Classification, Packaging and Labelling of Dangerous Substances and Preparations

2.2.1 Directive 67/548/EEC

Directive 67/548/EEC was the first harmonising Directive in the field of chemical products and has been subject to numerous amendments over the last 35 years. The objective of the Directive is the approximation of laws, regulations and administrative provisions in Member States relating to the classification, packaging and labelling of dangerous substances. The scope of the Directive **excludes**:

- medicinal products, narcotics and radioactive substances;
- the carriage of dangerous substances by rail, road, inland waterway, sea or air;
- munitions and objects containing explosive matter in the form of igniters or motor fuels; and
- dangerous substances exported to third countries.

In addition, the provisions relating to packaging and labelling are not applicable to containers for gases which are compressed, liquefied or dissolved under pressure.

For the purposes of the Directive, the term 'substances' represents chemical elements and their compounds as they occur in a natural state or as produced by industry. 'Preparations' means mixtures or solutions composed of two or more substances. The classification of dangerous substances is based on categories defined within the Directive on the basis of the hazards and risks they pose to the environment and health. A list of a few thousand substances with EU harmonised classifications is provided as Annex I to the Directive. Substances not on this list should be self-classified by their suppliers.

The labelling of dangerous substances must include: the name of the substance; the origin of the substance (name and address of the manufacturer, distributor or importer); the danger symbol and indication of danger involved in the use of the substance; and a reference to the special risks arising from such dangers. Such information needs to comply with the Annexes to the Directive, which prescribe the symbols, standard phrases, etc. that need to be used. The same applies to any advice on safety precautions.

The Directive has been amended several times and has been adapted to technical progress twenty-eight times, the most recent being Directive 2001/59/EC.

2.2.2 Directive 1999/45/EC

Directive 1999/45/EC approximates the laws on the classification, packaging and labelling of dangerous preparations to ensure protection of public health and the environment as well as free movement of such products. Its implementation repeals Council Directive 78/631/EEC (pesticides), Council Directive 88/379/EEC and Commission Directive 91/442/EEC (packaging with child-resistant fastenings).

The provisions on classification, packaging and labelling are based on the criteria laid down in Directive 67/548/EEC. A dangerous preparation is a preparation that:

- contains at least one dangerous substance within the meaning of Article 2 (definitions of dangerous substances);
- is considered to be dangerous, after evaluation, because of its physico-chemical properties, or the dangers that it poses to health or to the environment. The methods of evaluation for these three criteria are set out in the Annexes; or
- is not considered dangerous within the strict meaning of the Directive but may nevertheless present a specific danger. These preparations are specified in the Annex to the Directive.

A range of preparations are excluded from the scope of the Directive, with these including medicinal products for human or veterinary use, cosmetic products, animal feed, and preparations containing radioactive substances (see the Directive for the full list of exclusions).

Beyond the requirements for packaging and labelling, Directive 1999/45/EC requires that Member States appoint a national authority responsible for the exchange of information with the Commission on the application of the Directive. All information on the classification of the preparation should be made available to the competent national authority by the entity responsible for placing the preparation on the market. This includes safety data sheets to assist professional users in taking the necessary measures for safety and health protection at the workplace. The provisions on safety data sheets (SDS) are provided in Directive 91/155/EEC amended by Directive 93/112/EC and Directive 2001/58/EC as described below. This last modification incorporates the new obligations regarding safety data sheets included in Directive 1999/45/EC, which was adapted to technical progress by Directive 2001/60/EC.

Member States may not prohibit, restrict or impede the placing on the market of dangerous preparations which satisfy the requirements of the above-mentioned Directive. However, if they decide to grant a derogation to a dangerous preparation, they need to inform the Commission which will decide to uphold or not the Member State's decision.

2.2.3 Relevance of Directives 67/548/EEC and 1999/45/EC to the New Chemicals Policy

The two Directives play an indirect role in the protection of the safety and health of workers by ensuring that the information on the hazards and risks from chemical substances and preparations is complete in that it takes into account available information and up-to-date. That is the reason for the frequent adaptations to technical progress of Directive 67/548/EEC.

It is of note that these Directives set out the criteria for category 1 and 2 carcinogens, mutagens, and reproductive toxins, which will be subject to authorisation under REACH. Furthermore, through the introduction of REACH, numerous substances are expected to be reclassified, or classified for the first time as new information becomes available for existing substances. This will assist in the better protection of workers in

the workplace through the dissemination of more complete information on the hazards and risks from existing chemicals.

2.3 Directive 89/391/EEC – Improvements in Occupational Health and Safety

2.3.1 Main Provisions

EC legislation on the protection of workers from hazards at the workplace has as a starting point Council Directive 89/391/EEC of 12 June 1989, on the introduction of measures to encourage improvements in the safety and health of workers at work (OJ L 183, 29/06/1989 pp. 1-8). This Directive applies to all sectors of activity, both public and private, with the exception of certain activities in the public and civil protection services.

The objective of the Directive, as set out in Article 1, is to ensure a higher degree of protection of workers in the workplace. This is achieved through the implementation of preventive measures to guard against accidents at work and occupational diseases, and also through the provision of information, consultation, balanced participation and training of workers and their representatives. This Directive provides the framework for subsequent EC Directives covering a number of different areas.

The Directive lays down the obligations of employers and workers for achieving the objectives of the Directive. Employers are obliged to act for the protection of their employees' safety and health by:

- focusing on the principles of prevention, without involving the workers in any financial cost;
- evaluating occupational risks, including consideration of the choice of work equipment, the fitting-out of workplaces, the purchase of adequate protective and preventive services;
- maintaining a register of occupational accidents;
- making provisions for first aid, fire-fighting, evacuation of workers and action required in the event of serious and imminent danger; and
- providing information, consultation and training to workers and allowing them to take part in discussions on the improvement of safety and health in the workplace.

On the other hand, workers are responsible for:

- using machinery and equipment correctly, including personal protective equipment and safety equipment;
- notifying employers of shortcomings and situations in the workplace that could compromise workers' safety and health; and
- co-operating with management to fulfil the requirements imposed for the protection of safety and health and minimisation of risks.

There is a requirement to monitor workers' health in accordance with national laws and practices and to offer protection to sensitive risk groups from the dangers that specifically affect them.

2.3.2 Relevance of Directive 89/391/EEC to the New Chemicals Policy

Although Directive 89/391/EEC does not specifically target chemicals at work and the protection of workers from risks associated with chemicals, it sets the framework for an avoidance-based strategy. The additional information generated under REACH should assist employers in broad terms to comply with the provisions of this Directive. In particular, REACH should in theory assist in compliance with Article 6, paragraph 2(f) and Article 6, paragraph 3(a), which refer to employers' obligations. These require that employers:

"…replace the dangerous by the non-dangerous or the less dangerous…" (Article 6, §2(f)); and

"…evaluate the risks to the safety and health of workers, *inter alia* in the choice of work equipment, the chemical substances or preparations used, and the fitting-out of work places…" (Article 6, §3(a)).

2.4 Directive 89/656/EEC – Use of Personal Protective Equipment

Directive 89/656/EEC, which is the third individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC, laid down minimum requirements for personal protective equipment used by workers at work.

It is not envisaged that the introduction of the New Chemicals Policy will impact directly on the safety and health of workers with regard to the manufacture and use of PPE.

2.5 Directive 90/394/EEC – Protection of Workers from Occupational Exposure to Carcinogens (and Mutagens)

2.5.1 Main Provisions

Directive 90/394/EEC was introduced under the framework of Directive 89/391/EEC, and implemented in December 1992. Its objective is to lay down the minimum requirements for protecting workers against exposure to carcinogens. To achieve this, it incorporates limit values for exposure to carcinogenic chemical substances.

The Directive requires that the nature, degree and duration of the exposure of workers to carcinogens at the workplace should be determined, for the risks from exposure to be assessed and mitigated. It therefore includes provisions on:

- reduction and replacement of the carcinogenic agents;
- prevention and reduction of exposure (including access to risk areas);

- provision of information to competent authorities;
- unforeseen exposure (essentially, employers must inform the workers and apply measures for the protection of their safety and health); and
- foreseeable exposure (working together with workers to take the necessary measures, including measures on hygiene and personal protection and provision of information and training).

In addition, employers are responsible for co-operating with competent authorities in the fields of health surveillance and record-keeping for workers whose occupation may lead to exposure to carcinogens.

Article 16 stipulates that the European Commission will set limit values for exposure to carcinogens. Annex I lists a number of substances and activities which fall within the scope of the Directive, while Annex III to the Directive provides the first exposure limit for benzene; limits for other substances are given in other legal instruments.

2.5.2 Amendments to the Directive

Directive 97/42/EC amended Directive 90/394/EC, making clear that issues of exposure to asbestos and vinyl chloride are dealt with in separate legislation and, therefore, that the provisions of Directive 90/394/EEC apply only when they are "more favourable to safety and health at work". In addition, an amended definition of carcinogen was introduced:

- a substance which meets the criteria for classification as a category 1 or 2 carcinogen set out in Annex VI of Directive 67/548/EEC;
- a preparation composed of one or more substances referred to in the point above, where the concentration of one or more of the individual substances meets the requirements for concentration limits for the classification of a preparation as a category 1 or 2 carcinogen, as set out either:
  - in Annex I to Directive 67/548/EEC, or
  - in Annex I to Directive 88/379/EEC[2] where the substance or substances do not appear in Annex I to Directive 67/548/EEC or appear in it without concentration limits; or
- a substance, preparation or process referred to in Annex I, as well as a substance or preparation released by a process referred to in Annex I.

Directive 1999/38/EC introduced a significant change in the scope of Directive 90/394/EEC, as it was expanded to include mutagens. The basis for the amendment was again the list of substances included in Directive 67/548/EEC. Member States are obliged to bring into force the laws, regulations and administrative provisions necessary to comply with this Directive no later than 29 April 2003.

[2] Council Directive 88/379/EEC of 7 June 1988 on the approximation of the laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparations (repealed by Directive 1999/45/EC).

2.5.3 Relevance of Directives 90/394/EEC and 99/38/EC to the New Chemicals Policy

Directive 1999/38/EC is to be fully transposed into national law in the Member States by April 2003; therefore, benefits to the health of workers from its provisions have yet to be realised. Such benefits are not expected to be apparent for another 10 to 20 years given the latency of many cancers (10-20 years).

The combined effects of 90/394/EEC and 99/38/EC are that a high level of protection is provided for those carcinogens and mutagens that have been identified. Furthermore, one might expect further carcinogens and mutagens to be identified as a result of this legislation and taken into account in the future. As new information arises, then provisions on the protection of workers' health and safety can be amended with an adaptation of the existing Directive to technical progress. Thus, the levels of cancer associated with occupational exposure to carcinogenic substances that have been identified to date will be decreased as a result of this Directive and related legislation at national level. It is difficult to predict, though, what reduction in occupational exposure-related cancers in the future will result from these two Directives.

The aim of this legislation is to provide a high level of protection to workers from exposure to carcinogens and mutagens. However, its effectiveness in practice is reduced by the limited amount of information that is available on most of the existing chemicals currently being used in the EU (see, for example, Allanou *et al.* (1999) for a discussion on the availability of data).

One of the key features of REACH will be data generation on the toxicological properties of chemicals. The Policy's provisions for the collection of information on chemicals are expected to result in the identification of the carcinogenic or mutagenic properties of chemicals, which are currently unknown. The White Paper (CEC, 2001) indicates that a further 500 carcinogenic, mutagenic and reproductive toxic substances are expected to be identified through the data generation requirements.

Under REACH, substances which are identified as being category 1 and 2 carcinogens will be subject to authorisation, with a socio-economic assessment required to justify continued use in individual applications. This would enhance the impacts of Directive 90/394/EEC.

Overall then, although further reductions in occupational cancer cases will be realised in the absence of REACH, such benefits may be realised sooner and it is expected that additional CMRs will be identified through REACH.

2.6 Directive 91/155/EC – The Safety Data Sheets Directive

2.6.1 Main Provisions

Directive 91/155/EEC requires any person in the Community who is responsible for placing a dangerous substance or preparation on the market, (manufacturers, importers or distributors) to supply the recipient (industrial user) of the substance or

preparation with a safety data sheet (SDS). The provision of information is to be free of charge, at the latest when the substance or preparation is first supplied and thereafter following any revision due to any significant new information regarding safety and protection of health and the environment.

If the substance and preparation is offered or sold to the general public accompanied by sufficient information to enable users to take the necessary measured for their protection and safety, an SDS is not required to be provided. However, an SDS should be provided to an industrial user on request. Article 3 to the Directive outlines the types of information that are required to be included in the SDS for substances and preparations:

1. identification of the substance or preparation and of the company or undertaking;
2. composition/information on ingredients;
3. hazards identification;
4. first-aid measures;
5. fire-fighting measures;
6. accidental release measures;
7. handling and storage;
8. exposure controls/personal protection;
9. physical and chemical properties;
10. stability and reactivity;
11. toxicological information;
12. ecological information;
13. disposal considerations;
14. transport information;
15. regulatory information;
16. other information.

2.6.2 Amendments to the Directive

Directive 91/155/EEC has been amended twice, by Directive 93/112/EEC and more recently by Directive 2001/58/EC. These amendments mainly reflect alterations to Directive 67/548/EEC and the introduction of Directive 1999/45/EC[3]. In addition, Directive 2001/58 amends Article 1 (1) of Directive 91/155/EEC in that the "industrial user" is renamed to "professional user" and the conditions under which the provision of an SDS is required change.

The person responsible for placing a chemical substance or preparation on the market should provide a SDS if the substance or preparation is classified as dangerous according to Directive 67/548/EEC or Directive 1999/45/EC (Articles 5, 6 and 7). This person is also responsible for providing a SDS on request if the preparation is not classified as dangerous according to Directive 1999/45/EC but contains at least one substance posing health or environmental hazards in an individual concentration of 1 % by weight for non-gaseous preparations and 0.2 % by volume for gaseous

[3] Directive 1999/45/EC of the European Parliament and of the Council of 31 May 1999 concerning the approximation of the laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparations

preparations, or one substance for which there are Community workplace exposure limits.

Member States are required to apply the laws, regulations and administrative provisions referred to above to:

a) preparations not within the scope of Council Directive 91/414/EEC on the placing of plant protection products on the market, or Council Directive 98/8/EC on the placing of biocidal products on the market as from 30 July 2002; and
b) preparations within the scope of Directive 91/414/EEC or Directive 98/8/EC as from 30 July 2004.

2.6.3 Relevance of Directive 91/155/EEC to the New Chemicals Policy

REACH is expected to play a fundamental role in the improvement of SDS under Directive 91/155/EEC (as amended), through the generation of new toxicity data for existing substances. The toxicity and exposure data collected as part of the registration process will be used to amend or produce SDS, which will also be required for registration purposes. As a result, REACH will address and correct a current failing of the Directive regarding enforcement at the national level.

This should have a direct impact on the protection of workers' safety and health from substances and preparations on which limited information currently exists. It also means that professional users of chemicals will have better information on the properties of chemicals, which in turn will allow them to adopt appropriate protection and other measures when handling and using a product.

2.7 Directive 92/85/EEC – Protection of the Pregnant Worker

2.7.1 Main Provisions

Directive 92/85/EEC implements measures to encourage improvements in the safety and health at work of pregnant workers and workers who have recently given birth or who are breastfeeding.

The Directive imposes a number of obligations on employers. These include:

- assessment of any risks to safety or health and any possible effect on the pregnancy or on breastfeeding for workers; and
- taking the necessary measures to ensure that exposure of workers to any such risks is avoided (applying protective measures or moving the worker to another job or granting leave in accordance to national legislation and/or national practice to protect the worker's health).

Annex I incorporates a non-exhaustive list of agents, processes and working conditions for which the employer needs to assess the nature, degree and duration of

exposure for pregnant or breastfeeding workers in the establishment of concern (article 4(1)). The chemical agents included in Annex I are:

a) substances labelled R40, R45, R46, and R47[4] under Directive 67/548/EEC in so far as they do not yet appear in Annex II of the Directive;
b) chemical agents in Annex I to Directive 90/394/EEC;
c) mercury and mercury derivatives;
d) antimitotic drugs;
e) carbon monoxide; and
f) chemical agents of known and dangerous percutaneous absorption.

Annex II describes the agents and working conditions to which, in accordance to Article 6, exposure is prohibited. Pregnant and breastfeeding workers are under no circumstances to be obliged to perform duties if a risk has been established from exposure to lead and lead derivatives in so far as these agents are capable of being absorbed by the body.

2.7.2 Relevance of Directive 92/85/EEC to the New Chemicals Policy

The New Chemicals Policy will not impact directly on the implementation of Directive 92/85/EEC in Member States. However, through the new information provided under REACH, further chemicals may need to be classified with risk phrases R45, R46 or R60 and R61 (which have replaced R47) as having the potential for percutaneous absorption. Such substances will be subject to authorisation under REACH, ensuring the protection of workers more generally.

2.8 Directive 98/24/EC – Protection of Workers Safety and Health from Chemical Agents at Work

2.8.1 Main Provisions

Directive 98/24/EC laid down minimum requirements for the protection of workers from risks to their safety and health arising, or likely to arise, from the effects of chemical agents that are present at the workplace or as a result of any work activity involving chemical agents. The Directive defines the terms "chemical agent", "hazardous chemical agent", "activity involving chemical agents", "occupational exposure limit value", "biological limit value", "health surveillance", "hazard" and "risk" and the lay-out and content of data sheets is one of its elements .

The Commission is required to propose European objectives, in the form of indicative occupational exposure limit values for the protection of workers from chemical risks. These are to be set at Community level on the basis of a scientific assessment of the relationship between the health effects of hazardous chemical agents and the level of occupational exposure (in consultation with the Advisory Committee on Safety, Hygiene and Health Protection at Work).

[4] Note that R47 has been replaced by R60 and R61.

The limit values must be established or revised, taking into account the availability of measurement techniques, and should be notified to both workers' and employers' organisations. Member States must establish a national occupational exposure limit value, taking into account the Community limit value for any given chemical agent and notify the Commission thereof. When binding occupational exposure limit values are set by the Commission, Member States must establish a corresponding national binding occupational exposure limit value that does not exceed the Community limit value. The same applies to binding biological limit values.

Employer's Obligations

The employer must determine whether any hazardous chemical agents are present at the workplace and assess any risk to safety and health arising from their presence, taking into consideration:

- their hazardous properties;
- information on safety and health provided by the supplier;
- the level, type and duration of exposure;
- the circumstances of work involving such agents, including their amount;
- any national occupational exposure or biological limit values;
- the effect of preventive measures taken or to be taken; and
- the conclusions to be drawn from any health surveillance already undertaken.

The employer should carry out risk assessments and should keep them up-to-date. If more than one hazardous agent is present in the workplace, the assessment should target the risk posed by all chemical agents in combination.

In accordance with Article 6 of Directive 89/391/EEC, measures should be taken to eliminate or reduce to a minimum the risks from chemicals. These could entail:

- changes to the design and organisation of systems of work;
- provision of suitable equipment for any work with chemical agents;
- reduction to a minimum of the number of workers exposed or likely to be exposed;
- reduction to a minimum of the duration and intensity of exposure;
- appropriate hygiene measures;
- reduction of the quantity of chemical agents present at the workplace to the minimum required for the type of work concerned; and
- suitable working procedures.

If the risk assessment reveals unacceptable risks to the safety and health of workers, the employer must ensure that the risk is eliminated or reduced to a minimum, preferably by substitution (replacing a hazardous chemical agent with a chemical agent or process which is not hazardous or less hazardous). Where substitution is unfeasible, the following protection and prevention measures must be taken, listed in order of priority:

- design of appropriate work processes and engineering controls and use of adequate equipment and materials so as to avoid or minimise the release of hazardous chemical agents;
- application of collective protection measures at the source of the risk; and
- application of personal protection measures.

If occupational exposure limit values have been exceeded, the employer must immediately (in order of priority):

- prevent the presence at the workplace of hazardous concentrations of inflammable substances or hazardous quantities of chemically unstable substances or, where the nature of the work does not allow that;
- avoid the presence of ignition sources or the existence of conditions with an adverse effect on chemically unstable substances; and
- mitigate the detrimental effects in the event of fire or explosion, or harmful physical effects arising from unstable substances.

The Directive also includes provisions for arrangements to deal with accidents, incidents and emergencies, provision of information and training to workers and consultation and participation of workers. Also the issues of health surveillance in the Member States and of derogations are addressed, where the latter may be requested where there is clear justification.

Annexes and Binding Exposure Limits

Annexes I and II include binding occupational and biological exposure limit value for lead and its compounds. In addition, Annex III presents a number of chemical agents for which the production, manufacture or use at work is prohibited (2-naphthylamine and its salts; 4-aminodiphenyl and its salts; benzidine and its salts; and 4-nitrodiphenyl). The prohibition does not apply if these chemical agents are present in another chemical agent, or as a constituent of waste, provided that its individual concentration therein is below 0.1% w/w.

2.8.2 Supporting Legislation

Commission Directive 2000/39/EC arose from the requirements of Directive 98/24/EC for the establishment of European objectives in the form of indicative occupational exposure limit values for the protection of workers from chemical risks.

A first and a second list of indicative occupational exposure limit values were established by Commission Directives 91/322/EEC and 96/94/EC in the framework of Council Directive 80/1107/EEC on the protection of workers from the risks related to exposure to chemical, physical and biological agents at work (which was repealed by Directive 98/24/EC). Directive 2000/39 essentially re-enacts the indicative limit values in the framework of Directive 98/24/EC.

The list provided in the Annex to the Directive contains the substances set out in the Annex to Directive 96/94/EC. It also incorporates a number of other agents for which indicative occupational exposure limit values were recommended by the Scientific

Committee for occupational exposure limits to chemical agents (SCOEL), following the evaluation of the available scientific data on occupational health effects and taking into account the availability of measuring techniques. Subsequently, and to ensure clarity of the legislative framework, 96/94/EC was recast (as of 31 December 2001).

Member States have to establish national exposure limit values taking into account the Community limit values as presented in the Annex to the Directive.

2.8.3 Relevance of Directive 98/24/EC to the New Chemicals Policy

Directive 98/24/EC is designed to provide a high degree of protection for workers against the effects of occupational exposure to chemicals. As for other Directives, however, its effectiveness is limited to the protection of workers in relation to those properties of chemicals that are known. As there is no obligation on manufacturers and importers under the current system to generate data on the properties of existing substances, such data do not exist for the majority of chemicals placed on the market.

REACH will therefore be important to the implementation of Directive 98/24/EC by providing more detailed information on chemical agents in the workplace. Not only will more data be available on the hazardous properties of chemical agents, this new information may also lead to amendment of national and Community-wide occupational exposure limit values as included in the Annex to Directive 2000/39/EC.

2.9 Directive 96/82/EC - Control of Major Accidents Involving Dangerous Substances

2.9.1 Main Provisions

The aim of Directive 96/82/EC (known as the Seveso II Directive), is to prevent major accidents involving dangerous substances and limit their consequences for humans and for the environment with a view to ensuring high levels of protection throughout the Community in a consistent and effective manner. It replaced and broadened the scope of Directive 82/501/EEC (Seveso I) and was the first Directive to incorporate substances considered dangerous to the (aquatic) environment within its scope.

The Directive applies to any “establishment” (excluding certain types of establishments/activities) where dangerous substances are present or could be produced as a result of an accident in quantities equal to or exceeding threshold values given in the Annex I to the Directive. A list of definitions of key terms is also provided. According to Article 3 “establishment” means the whole area under the control of an operator where dangerous substances are present in one or more installations, including common or related infrastructures or activities. On the other hand, “operator” means any individual or corporate body that operates or holds an establishment or installation or, if provided for by national legislation, has been given decisive economic power in the technical operation thereof.

In accordance to the Directive requirements, Member States must ensure that operators are undertaking all measures necessary to prevent major accidents and to limit their consequences for man and the environment. Operators must send notifications to competent authorities of possession of dangerous substances for both new and existing establishments, and must draws up documents setting out their major-accident prevention policy. In addition, safety reports must be produced, containing updates on the inventory of the dangerous substances present at an establishment, emergency plans need to be prepared and reviewed, and information should be made available to the public on safety measures in the event of an accident.

2.9.2 Relevance of Directive 96/82/EC to the New Chemicals Policy

It is expected that the introduction of REACH will affect the implementation of Directive 96/82/EC to a considerable degree, through the collection of additional information on chemical substances. Additional information will essentially mean that a number of substances are likely to be added in the list of dangerous substances (as defined within Council Directive 67/548/EEC as amended and adapted to technical progress) and will therefore be subject to the qualifying threshold quantities indicated in Annex I, Part 2 of the 96/82/EC Directive.

Establishments where these newly classified substances are present or are likely to be produced as a result of an accident in quantities equal to or exceeding these threshold values will then be subject to the obligations prescribed within Directive 96/82/EC. At present, it is not possible to estimate the number of establishments that will be impacted by the introduction of REACH.

2.10 Implications of Existing Legislation for Evaluation of the Impacts of the New Chemicals Policy

In assessing the impact of the New Chemicals Policy on occupational health, it is important to take into consideration the provisions of existing legislation, as outlined above.

A considerable body of legislation is already in place to protect workers from the effects of occupational exposure to chemicals. The legislation requires employers to identify risks associated with chemicals in the workplace and to adopt appropriate measures to limit these risks. Specific provisions exist to address the risks associated with carcinogens and with chemical agents as a whole. Once this legislation is fully implemented, it can be expected to lead to a reduction in the incidence of ill-health associated with occupational exposure to chemicals. However, effective implementation of the legislation relies on having information on the properties of chemicals used in the workplace. The fact that such data are not available for the majority of existing substances currently being used within the EU is a key constraint to achieving the goals of the legislation.

For example, 80% of priority substances assessed under the Existing Substances Regulation (ESR) were identified as presenting unacceptable risks, with many of these being risks in the workplace, including unacceptable risks from carcinogens.

Although the assessments prepared under ESR indicate that current risk management in relation to worker health and safety is often sufficient, they have also shown that it is not sufficient in some cases, owing to the lack of available information.

For the limited number of substances whose hazardous properties are already well known, REACH is unlikely to provide information that will alter their treatment under the current legislation. For example, the Policy is likely to have limited effect in reducing occupational diseases from known carcinogens or mutagens, as the risks of these are already controlled on the basis of their proven or suspected carcinogenic or mutagenic properties. However, REACH will provide the information necessary to identify other substances currently unknown as having carcinogenic and mutagenic properties, or that may be causing other occupational diseases.

Through the registration process, REACH will provide the currently missing data on the properties of existing substances that are required to ensure the successful and effective implementation of the above Directives. It will also ensure that such data continue to be provided for new substances. Because information will be more readily available than under the current system, authorisation under REACH should ensure better compliance with worker protection legislation. The need to document what types of worker safety measures should be followed as part of use in registration dossiers (under risk management) will also further help downstream users and health and safety inspectors ensure that adequate controls are in place.

In conclusion, REACH is most likely to have an impact where the causes of occupational illnesses are not known and may be associated with a range of chemicals. Examples include some causes of asthma and other respiratory illnesses, skin diseases, effects on the central nervous system and certain cancers.

3. DATA ON HEALTH IMPACTS AND EXPOSURE TO CHEMICALS

3.1 Introduction

3.1.1 Additional Data Collection

Data on occupational health have been gathered from a number of sources for the purposes of this assessment, including published sources such as Eurostat and those produced by Member State Competent Authorities. We have consulted with international organisations (such as the World Health Organisation and the International Labour Organisation), Health and Safety Authorities across the EU (Ministries of Health and Employment, other government agencies). In addition, a small number of experts were consulted with regard to current research in the EU on a number of end-points from chemical exposure (for instance, sensitisation). However, within the budget and timescale available, it has not been possible to ensure that the data are complete. Nor has it been possible to undertake a more comprehensive consultation exercise.

The readily available data are often reported in different forms, requiring some analysis and manipulation to make them comparable with other available information. In order to develop scenarios to act as the basis for predicting the potential health impact reductions stemming from REACH, it has been necessary to rely on only a subset of the data collected. However, the remainder of the information gathered has informed the approach to defining the health impact scenarios and to understanding the potential implications of REACH.

3.1.2 Definitions

In analysing the data, it has been important to be clear on the agreed definitions applied to the key terms used in statistics on occupational health and safety and in the literature on the subject. The key terms and their definitions are set out in Table 3.1.

Table 3.1: Definitions of Key Statistical Terms

Term	Definition
Work-place accident	Any unplanned event that resulted in injury or ill-health of worker(s).
Work-related ill health	Any illness, disability or other physical problem that was caused or made worse by one's work
Prevalence of a disease	Number of people in a given population who have the disease at one particular time (for instance, if we examine a sample of 100,000 EU citizens and find that 15 of them are asthma sufferers at present, this indicates a prevalence of 15 in 100,000, which can be extrapolated to the total EU population)
Incidence of a disease	Number of new cases of the disease over a given time period (for instance, if 300 people develop asthma in Finland during the 12 months of the year 2002, then the incidence of asthma in the Finnish population for the given year will be 300).

The applicability of the different terms can vary with circumstances. For example, sometimes prevalence is a more meaningful concept than incidence and sometimes it is the other way round. If we suspected there was an epidemic of a certain illness, we might want to look at the incidence of that illness over the past year and compare it with the incidence in previous years to see if it was much higher. If we were interested in whether the proportion of people currently suffering from asthma was decreasing over time, we would look at the prevalence and compare that with the prevalence of, say, 10 years ago.

For the purposes of this assessment, incidence data are more relevant and provide the basis for understanding the number of cases of illness in the future that may be avoided owing to the data provision and authorisation activities within REACH.

3.2 Summary of Available Data

3.2.1 Occupational Health and Safety Data

Annex 1 to this report lists the data collated on chemicals-related occupational health, general occupational health, and occupational diseases in the chemicals sector.

Data have been collected at the following levels:

- general data on the number of occupational diseases in the EU as a whole (Eurostat) and for specific countries (such as the Netherlands, Portugal and the UK) irrespective of their cause;
- statistics on the number of cases of particular diseases for the EU and for Member States;
- data on numbers of occupational diseases associated with exposure to chemicals, where this is often in relation to specific chemicals;
- data on numbers of occupational diseases associated with ‘unspecified’ or ‘unknown’ chemicals.

The availability of data on occupational diseases varies between the EU and member state level, with a good range being available for Germany and the UK (major chemical producers and downstream users), as well as for several of the other EU countries. The data also vary in terms of the disease end-points that are covered and the degree to which the data separate chemicals-related cases from other causal agents or activities.

As the data become more specific to chemicals-related disease, the number of countries for which detailed figures are available decreases. This is particularly true for data on numbers of occupational diseases associated with ‘unspecified’ or ‘unknown’ chemicals. We believe these are the most relevant data as they will reflect cases where there is no clearly known causal agent (although in the case of unspecified chemicals it may also reflect poor or incomplete reporting). In some cases, figures are produced by only one or two countries, making extrapolation to the EU difficult (especially where the countries reporting such figures are the smaller countries).

The approach adopted in relation to cancer varies slightly from that for other occupational diseases. In this case, data have been collected on the incidence of cancer within the EU population as well as on numbers of deaths for different types of cancer. In addition, the results of an EU-wide study (Kogevinas *et al* (1998) on occupational exposure to carcinogens, including chemicals, radiation organic material, etc., were made available. The CAREX database that formed one part of this study provides data on exposures to carcinogens for the years 1990-1993 across all workers in the EU. Unfortunately, these data reflect exposures to known and suspected carcinogens and therefore do not help in identifying the currently unknown carcinogens that are of most interest to this study. Furthermore, although there are estimates of the number of cancers that are due to occupational exposure, health experts have indicated that the majority of these relate to known or suspected carcinogens. We have been able to find no reliable statistical data on the numbers of cancers resulting from exposure to unknown carcinogens. This is discussed further below.

Specific data on occupational accidents in the chemicals industry are also available. However, review of these indicates that it is unlikely that REACH would reduce the numbers of accidents or impact on accident types, as most have non-chemical-specific causes. As a result, the focus of this study is on illnesses and not accidents.

3.2.2 Data Reliability and Use of Adjustment Factors

Combining data from different sources is not always straightforward or feasible. While some sources (i.e. the UK, Italy or Spain) provide information on an extensive list of diseases classified by causative agent, other available sources (i.e. Austria) provide only overall figure for chemical-related occupational accidents. This makes it necessary to extrapolate from a sub-set of countries to the EU as a whole. In general, the approach that has been adopted for extrapolation has been based on estimating incidence rates amongst the worker population for individual countries and then using the average figure to predict the number of cases at the EU level. This is often complicated by the fact that data are provided for different years. It is recognised that this process of extrapolation introduces uncertainty into the final estimates; however, it should provide at least an indication of actual numbers.

It should be noted that the available national data for some diseases do not appear to correlate well with Eurostat figures for the EU-15. A simple extrapolation of national figures to the EU-15 total does not produce figures of a similar order to the total provided in the Eurostat statistics. This could be due to low reporting rates from Member States to Eurostat officials or to different classifications being adopted. In the analysis presented below, we contrast national data with EU statistics where available and set up upper and lower limits on the resulting estimates.

A final issue of concern is that there can be a significant time lag between the cause of a work-related disease and its effects, and it is therefore important to realise that statistics will to an extent reflect past rather than present working conditions. However, it is impossible to identify lags except at the individual level, and government bodies (such as the UK HSE (1999c)) indicate that for acute effects analysis shows that a high proportion of absences can be attributed to illnesses caused

by fairly recent working conditions. Thus, recent statistics can be assumed to be a good indicator of the impacts likely to flow from present working conditions for acute effects. This may not be the case, however, for cancer effects.

3.2.3 Identification of Health End-Points

Given the need to consider only the additional benefits that would be provided by REACH, we have examined the end-points for which chemical specific data are available. These are summarised in Table 3.2. As can be seen from this table, some of the data are not relevant to this study as they relate to causes that would not be addressed by REACH, for example, asbestos, organic matter and coal dust.

In most cases, however, more than one group of chemicals is indicated as being relevant to a particular end-point. These sometimes include substances identified as CMRs (such as cadmium and mercury), to which exposure in the workplace will already be strictly controlled through the existing occupational health and safety legislation discussed in Section 2. For several of the end-points, though, substances that are not currently subject to such stringent controls have been identified as being the causative agents. Although instructions on safe handling may be provided for some of these substances, the lists also include causative agents which may be preparations containing a range of substances for which the relevant human health test data may be lacking (e.g. glues, inks, cleaners, resins, etc.).

As a result, we believe that the information set out in Table 3.2 provides a basis for establishing the types of occupational diseases that are likely to be reduced through the additional information generated through the registration of chemicals and through the authorisation of CMRs under REACH.

In particular, we believe that the following end-points are likely to be affected:

- **Skin**: eczema, allergic contact dermatitis, irritant contact dermatitis;
- **Respiratory System**: asthma, allergic rhinitis, and other respiratory illnesses;
- **Eyes**: conjunctivitis;
- **Central Nervous System**: CNS disorders; and
- **Cancer**: various end-points, with a focus on those that stem from general chemicals exposure (as opposed to cancers arising from exposure to known carcinogens).

Table 3.2: End-points of Chemical Exposure at the Workplace		
Target	**Type of disease**	**Examples of causative agents**
Skin	Eczema	Hairdressing liquids; isocyanates
	Allergic contact dermatitis	Rubber chemicals and materials, soaps and cleaners, resins and acrylics, chromium and chromates, petroleum and products, hairdressing chemicals, aldehydes, cutting oils and coolants, solvents, glues and paints, printing inks
	Irritant contact dermatitis	Industrial solvents, inorganic acids and bases, oils and lubricants, detergents
	Urticaria	Carboxylic acid anhydrides
Respiratory system	Chronic obstructive pulmonary disease	
	Asthma	Isocyanates, platinum salts, hardening agents, aliphatic aldehydes, cobalt, nickel, latex
	Allergic rhinitis	Isocyanates (vehicle spraying), curing of epoxy resins (some glues, resins), carboxylic acid anhydrides
	Emphysema	
	Poisoning	Nitrous fumes, beryllium, cadmium
Eyes	Conjunctivitis	Sensitisers, industrial solvents
	Dystrophy of the cornea (including ulceration of the corneal surface)	
Cardiovascular system	Blood vessel anomalies	
	Heart disease	
Digestive system	Gastro-intestinal disorders	Chloromethane
Liver/kidney	Liver/kidney damage	Carbon tetrachloride, trichloromethane
Central nervous system (CNS)	CNS disorders	Mercury, solvents and diluents, paints and glues
	Peripheral neuropathy/chronic toxic encephalopathy	n-hexane, methyl n-butyl ketone
Cancer	Skin, lung, stomach, mesothelioma (pleural thickening), etc.	zinc chromates, benzene, coal tars, nickel suplphides, asbestos, cadmium oxide, chromium III, acrylonitrile, etc. (as per Annex I of 67/548/EEC)
Sources: Consultation and sources referred to in Table A.1 in Annex 1		

3.3 Skin Diseases

Data on both allergic and irritant contact dermatitis as the main occupational skin diseases of relevance have been collected for 10 EU Member States and for the EU-15, as a whole. This includes figures on the total number of occupational skin diseases and of chemicals related skin diseases for most of the countries. The total estimated number of occupational skin diseases in the EU is estimated at 18,280 based on extrapolation from data provided by seven countries. For chemicals-related occupational skin diseases arising from exposure to proven irritants and allergens, a

figure of 8,797 is reported by Eurostat for 1995. Data for eight of the Member States and for more recent reporting periods (1998 to 2001) indicate a total number of cases of about 9,660 for these eight countries; this corresponds to around 16,000 cases in total when extrapolated to the EU. These differences may reflect an increased number of irritants and allergens being identified between the 1995 and later data; it may also reflect underreporting. The sources of these data are presented in Table A2.1 of Annex 2.

For a number of the countries, the data on chemicals related skin diseases are not provided in enough detail to separate out those for which the causative agent is known and those resulting from unspecified or unknown chemicals. Being able to make such a distinction is important as the focus here is on those cases that result from non-specific or unknown chemical agents. As indicated above, these two types of causes are relevant as they will reflect those cases where there is no clear link to a particular chemical (although as noted above some unspecified cases may include those where the causal agent is known but has not been reported).

Data for the number of skin disease cases related to unspecified and unknown chemicals is available for only four countries: Belgium, Finland, Spain and the UK. The total number of such cases for these four countries is 2,889 and, when extrapolated to the EU based on employment figures, results in a total EU number of 12,087 cases of non-specific chemicals related skin diseases. This provides the upper bound estimate of the number of cases of skin disease avoided to result from improvements in safety data sheet information following the implementation of REACH.

For exposure to unknown chemical agents, 257 cases are reported for two of the four countries, with this leading to an estimate of 1,364 when extrapolated to the EU-15. This provides the lower bound estimate of the number of cases of skin diseases avoided as a result of the implementation of REACH.

It is important to note that the above figures exclude exposure to the following types of causal agents (together with exposure to substances known and classified for their effects in at least two cases):

- wet work;
- plants and moulds;
- personal protective equipment;
- temperature and humidity;
- flour;
- preservatives;
- latex;
- cobalt;
- chrominum;
- nickel;
- other metals and their compounds;
- cement;
- isocyanates;
- inorganic acids and bases;

- ammonium compounds; and
- medication.

3.4 Respiratory Diseases

The main respiratory diseases of concern here are asthma, allergic rhinitis, emphysema and other lower and upper respiratory diseases (with cancer related diseases having been excluded from the figures given below). For these end-points, general data on the total number of cases have been collected from 10 countries and for the EU as a whole. The total number of cases reported by the 10 countries is around 15,400, with this relating to data for 1998, 1999 and 2001 (varying across the countries). An EU figure of 9,653 cases of pulmonary diseases for workers below 56 years of age is reported for 1995 (Eurostat, 2002). Extrapolating the country data to the EU, so as to cover the additional respiratory end-points, leads to an estimate of 16,820 total occupational cases in total.

With regard to chemicals-related occupational respiratory diseases, Eurostat (2002) reports 4,540 cases of allergies from known allergens (sintered metals, copper, tin, barium and their compounds) for 1995. The total number of chemicals related cases reported by nine of the countries is 4,860, with this including more end-points (such as asthma and chronic bronchitis). Extrapolation of the country data to the EU leads to an estimate across all the relevant end-points of 6,700 occupational chemicals related respiratory diseases.

For exposure to non-specific and unknown chemicals, the number of data points on which to base EU-wide estimates is reduced to information from five countries (with only two providing data related to unknown chemicals). Through extrapolation of these data on the basis of EU employment data, an estimated 3,680 cases of respiratory illnesses stem from non-specific chemical agents, with 274 of these arising from unknown chemicals.

Note that some of the data (such as that for the UK) relate to ‘disablement’ cases, while that for other countries relates to ‘registered’ cases. Basing the estimates on ‘disablement’ may result in an underestimate for that country, and hence for the EU average.

Annex 2 provides a summary of the data used in the above calculations (Table A2.2). As for skin diseases, the figures for non-specific chemicals and unknown chemical agents provide upper and lower bounds for calculating the potential reduction in the number of cases of respiratory disease to result from improvements in safety data sheet information following the implementation of REACH.

3.5 Eye Disorders

More limited data are available on eye disorders. Eurostat (2002) indicates that there were 50 reported occupational eye disorders for 1995, with this covering all causal agents. However, data for the individual countries indicate that the EU figures are not reliable.

Only for Denmark, Finland and Sweden are there data on eye diseases resulting from chemical substances (with Sweden's figures covering chemical and biological agents). It is of note, though, that zero cases of eye diseases related to specific chemicals are reported for a few countries (such as the UK). No countries report cases for non-specific or unknown chemicals exposure. The available data are presented in Table A2.3 of Annex 2.

All of the data would appear to relate to incapacitation, with this suggesting that they are related to formal compensation claims for disablement. The numbers would therefore exclude cases that may cause temporary distress to workers but do not lead to lengthy incapacitation and, hence, claims for compensation.

Based on consideration of the data as a whole, we have assumed that around 500 cases of conjunctivitis stem from exposure to chemicals in an average year, and that 10% of these (50) stem from non-specified or unknown chemical agents.

3.6 Central Nervous System Related Disease

The two main types of disease of the central nervous system linked to chemicals are toxic encephalopathies and polyneuropathies, although the data may include some other disease end-points (such as registered brain damage).

In this case, data are not available from Eurostat for the EU as a whole. Instead, estimates have to rely solely on extrapolation from country data. Reporting at the country level (data are available for six countries) varies between the provision of data on total occupation CNS diseases or reporting only of those CNS diseases that are chemicals-related. Three countries give total figures, although for two of these countries all of the reported cases are linked to chemicals exposure.

Data are available, therefore, for all six countries on the number of cases that stem from chemicals exposure, with this totalling 204. Unfortunately, the data provided by Denmark appear to be inconsistent with those from the other countries. Denmark reported 110 cases of registered diseases in 2001, with 40 of these being nervous system diseases and 70 being cases of brain damage. These figures compare to the number of cases of nervous system diseases reported by countries such as Germany, the Netherlands and Sweden, which range from 18 to 33 (and which are higher than those reported for Finland and Austria, see Table A2.4 of Annex 2).

Only two countries report the data in a way which allows estimation of the number of cases that may be caused by non-specific chemical agents to be carried out. These are Austria and Sweden. For Austria, the causal agents are reported to be organic

solvents. For Sweden, a separate figure is given for cases caused by exposure to metals and isocyanates.

For the above reasons, it has been difficult to produce estimates of the likely number of cases of CNS diseases that are caused by exposure to chemicals and then by exposure to non-specific chemicals. Our best guesstimates are that, including diseases resulting in brain damage, some 570 cases of disease linked to chemicals exposure occur in the EU in a year. Of these, about 85% are linked to non-specific chemical agents, with this suggesting a figure of about 485 cases per year. There is insufficient information to determine what percentage of these non-specific cases may relate to unknown chemicals.

We believe that the figure of 485 cases should be treated as an upper bound estimate as to the potential reduction in CNS diseases that will be achieved owing to the fuller information that will be available under REACH. As a result, we also examine a lower bound estimate of 50 cases (based on the lowest figure reported by the six countries); this lower bound figure also corrects for the potential of cancers of the brain being included in the Danish data.

3.7 Cancer

The EUCAN database indicates that there were around 1.6 million new cases of cancer reported in 1997 (both men and women), excluding skin cancers. In addition, around 925,000 people in total are reported as dying of cancer (i.e. cancer was identified as the main cause) across all types of cancer except for skin cancer. These figures highlight the significance of cancer as a disease within the EU.

There are obviously numerous risk factors that may lead to the development of a cancer, with these including environmental, diet, socio-economic, genetic and other factors. Environmental factors will include exposure to chemicals both within and outside the workplace. Within the workplace, existing legislation will control exposure to known carcinogens, with Directives such as 99/38/EC expected to reduce the number of cancer deaths arising from known carcinogens in the future. However, there are likely to be unknown carcinogens currently in use. For example, the ECB indicate that data on the carcinogenicity of even high production volume substance is limited (Allanou *et al*, 1999). This finding is likely to underpin the White Paper estimate of 500 additional CMRs being identified as a result of REACH.

Eurostat (2002) data report that around 2,300 cases of cancer stem from occupational exposure to chemicals. These cases relate to exposure to known carcinogens. No data are available from Eurostat or national sources on the number of cases of cancer that arise from occupational exposure to non-specific or unknown chemical agents. Occupational health experts believe that the most significant carcinogens within the workplace have been identified and are being or will be controlled. However, it is also recognised that other chemicals that may play a role in the development of occupational cancer. These other chemicals may act in combination with other agents (chemical or non-chemical), thus increasing the overall risk of developing occupational cancer.

In order to estimate the potential number of such cases of occupational cancers arising from exposure to non-specific or unknown chemical carcinogens, an estimate of total cancers assumed to relate to occupational exposures is first required.

Research and consultation with experts has indicated that the preferred method for approximating the number of cancer deaths in the general population that can be attributed to occupational exposures (including both chemical and non-chemical carcinogenic agents) is based on the historic work by Doll and Peto (1981). This method provides the starting point for the IARC study, which was funded by the European Commission[5].

The work of Doll and Peto (1981) can be used to estimate the number of cancer deaths due to occupational exposure but does not provide a direct way of calculating deaths due to exposure to chemicals in the workplace (and obviously cannot provide a direct means of establishing the burden of cancer from occupational exposure to unknown chemical carcinogens). For this reason, the basis of our calculations, as described in Table 3.3 below, is the IARC study together with an ILO report (ILO, 2000) which calculates the number of cancer deaths from occupational exposure to chemicals. The ILO work is based on the findings of an Australian study by Morrell *et al* (1998) which also follows the pattern of the Doll and Peto study.

The IARC study considers the implications of the Doll and Peto work and then takes a more bottom up approach to estimating the number of cancer deaths attributable to occupational exposures. The study notes that lung and bladder cancer account for around 71% of occupational cancer deaths, but it does not attribute these to particular carcinogens. It also identifies a further 2,500 annual cancer deaths that may possibly be attributed to occupational exposures. However, within these figures there is also some uncertainty as to causes, for example with regard to bladder cancer in women. The report (Kogevinas *et al*, 1998) notes that "In women, no excess risk is found when using an a priori defined list of occupations at high risk of cancer defined on the basis of results from previously published literature." In addition, "a number of occupations were identified in the women bladder cancer set as having a statistically significant excess risk of bladder cancer. These occupations were not in their majority among the well identified high risk occupations for bladder cancer..." The report also notes that estimates of lung cancer deaths in men have not decreased over time, even though lower estimates would have been expected (presumably as a result of having identified and controlled exposure in the workplace to known carcinogens).

The Australian study utilises the Doll and Peto percentages of cancer deaths that can be attributed to occupational exposures and then makes assumptions on the number of cancer deaths due to occupational exposure to chemicals. The result is that these estimates (and thus those produced by the ILO on the global burden of chemicals-related occupational cancer deaths are) in-line with the work by Doll and Peto as described in the IARC report. What effectively differentiates the ILO work (and the RPA calculations below) from the Doll and Peto estimates is that not all end-points suggested by Doll and Peto are included in the calculations.

5 This method also acts as the basis for other organisations' estimates of occupational cancer deaths (for example, the UK Health and Safety Executive).

The ILO report confines its estimates to cancers of lung, liver, bladder, prostate, mouth, oesophagus, stomach, colorectal cancer and leukaemia. For these end-points, the global cancer deaths due to occupational exposure to hazardous substances were estimated at 236,556 (including 3,500 deaths from skin cancer), of which 50% were assumed to be deaths relating to Asian countries.

The calculations provided below are based on the ILO report and the Australian study, but also take into account the additional end-points considered in the Australian study and other research that indicates cancer end-points that relate to exposure to chemicals. For example, numerous end-points have been identified by Cancer Research UK (the foremost UK body in cancer research) as having chemicals exposure as a key risk factor.

Table 3.3 sets out the cancer end-points for both men and women which the IARC and Australian studies assume are linked to chemicals exposure. It is of note that only 16 out of 23 end-points reported in the EUCAN database are considered relevant to occupational chemicals exposure.

Table 3.3: Estimated Number of Cancer Cases Arising from Occupational Exposure to Chemicals (based on 1997 data)

Cancer	% of Cases Associated with Chemicals		Total EU Deaths from all Causes		Estimated EU Deaths from Exposure to Chemicals		Chemical Exposure Identified as a Risk Factor for UK Population
	Men	Women	Men	Women	Men	Women	
Oral cavity and pharynx	1.0%	0.5%	15,662	4,173	157	21	
Oesophagus	1.0%	0.5%	16,801	5,992	168	30	◆
Stomach	1.0%	0.5%	32,326	24,103	323	121	
Colon/Rectum	1.0%	0.5%	55,928	55,085	559	275	
Liver	4.0%	1.0%	21,997	11,746	880	117	◆
Pancreas	1.0%	0.5%	22,206	22,751	222	114	
Larynx	2.0%	1.0%	9,644	956	193	10	
Lung	15.0%	5%	139,747	41,004	20,962	2,050	◆
Prostate	1.0%	0	55,658	0	557	0	
Bladder	10.0%	5.0%	22,117	8,536	2,212	427	◆
Kidney, etc.	1.0%	0.5%	13,679	8,627	137	43	◆
Brain, nervous system	1.0%	0.5%	11,647	9,446	116	47	◆
Non-Hodgkin lymphoma	1.0%	0.5%	13,221	12,197	132	61	◆
Hodgkin's disease	1.0%	0.5%	1,389	1,085	14	5	
Multiple myeloma	4.0%	1.0%	6,975	7,210	279	72	
Leukaemia	10.0%	5.0%	15,561	13,559	1,556	678	◆
Total	**3.5%**		**510,059**	**383,682**	**28,467**	**4,071**	

Columns 2 and 3 indicate the percentage of cancer deaths out of the total for that end-point that are assumed to be caused by exposure to chemicals (specific and unknown). These percentages are multiplied by total the number of deaths from all causes to

develop estimates of the number of deaths resulting from exposure to chemicals. We have also indicated which of these end-points have been identified by Cancer Research as having chemical exposure as a key risk factor in developing the disease.

As can be seen from this table, around 32,500 cancer deaths (28,467 male and 4,071 female) are estimated as resulting from occupational exposure to chemicals using the IARC and Australian percentages and applying these to EU mortality data. In line with the IARC report, the largest numbers of occupational cancer deaths related to chemicals exposure are those stemming from lung and bladder cancer and leukaemia. For these end-points, 10% or more of all cancer deaths are assumed to stem from occupational exposure to chemicals.

As indicated above, these 32,500 cancer deaths, which represent around 3.5% of total cancer deaths in the EU, are considered to stem mainly from occupational exposure to known or suspected carcinogens. The findings of the IARC study and discussions with other occupational health experts suggest that around 20% of the 32,500 deaths may stem from exposure to unknown chemical carcinogens (with the remainder being associated with known or suspected carcinogens and thus being addressed by current legislation). This suggests that around 6,500 cancer deaths per annum are caused by occupational exposure to unknown chemical carcinogens.

For the purposes of this analysis, we assume that these unknown chemical carcinogens would not be identified in the absence of REACH. In other words, they would not be identified through worker occupational health monitoring or other chemical risk assessment activities. This assumption may overestimate the impacts of REACH. Furthermore, it is unlikely that worker protection measures taken in response to new information on these currently unknown chemical carcinogens would result in the number of cases being reduced to zero. As a result, it has been necessary to make further assumptions as to the percentage of cancer deaths that would be reduced as a result of additional information provision and authorisation under REACH.

The assumptions that have been agreed with the Commission to produce lower and upper bound estimates as to the number of future cancer deaths per annum that may be reduced by REACH are:

- lower bound: 2,167 future cancer deaths avoided per annum (one third of 6,500), with this equating to 0.23% of total cancer deaths per annum in the EU;
- upper bound: 4,333 future cancer deaths avoided per annum (two thirds of 6,500), with this equating to 0.47% of total cancer deaths per annum in the EU.

The above assumptions do not appear overly optimistic given that the lower and upper bound figures both correspond to less than 1% of total EU annual cancer deaths. The estimates can also be considered in the light of the expectations (in the White Paper) that REACH will identify a significant number of new CMR substances. For example, if REACH were to identify only 30 new carcinogens, these would need to be associated with only around 70 cancers per annum each to correspond to the lower bound estimate.

Such a low number of cancers would probably not be picked up by monitoring or epidemiological studies at a sectoral level. In addition, exposure to a particular chemical may not be identified as a risk factor given the low number of cases assumed here to be triggered by exposure to that substance. This is particularly true for those types of cancer that are linked to a number of disparate risk factors.

Finally, it is of note that the above analysis has only focussed on cancer deaths, due to the absence of data on the numbers of non-fatal cancers associated with exposure to chemicals. The numbers of those who develop cancer as a result of occupational exposure to chemicals but who survive may also be significant. For example, while only 5% of men and women in the UK survive lung cancer, 65% of men and 57% of women survive bladder cancer.

3.8 Occupational Disease Impact Scenarios

Table 3.4 summarises the two scenarios that act as the basis for the assessment provided in Section 5 on the value of the health impacts reduced as a result of the introduction of REACH. The lower bound figures relate to exposure to unknown chemicals while the upper bound scenario relates to exposure to non-specific chemicals for the end-points other than cancer. It is also assumed that the number of cases of disease will be reduced to near zero. For cancer, the lower bound scenario assumes that one third of those cancers stemming from unknown chemical carcinogens (6,500 in total) are reduced, while the upper bound assumes that two thirds will be reduced.

More generally, the two scenarios reflect the uncertainty surrounding the actual impact that additional information provision and authorisation under REACH will have on chemicals related occupational diseases.

Table 3.4: Health Impact Scenarios on the Number of Cases Reduced Under REACH

Health End-Point	Cases Associated with Exposure to Unknown Chemicals – LOWER BOUND	Cases Associated with Exposure to Non-Specific Chemicals - UPPER BOUND
Skin Diseases	**1,350**	**12,000**
Respiratory Diseases	**275**	**3,680**
Eye Disorders	**50**	**50**
CNS Diseases	**50**	**485**
Cancers	**2,167**	**4,333**

4. VALUATION OF HUMAN HEALTH EFFECTS

4.1 The Basis for Economic Valuation

The next step in considering the potential impacts of REACH on occupational diseases is to calculate the economic value of the reduction in the number of cases of occupational diseases. The rationale for estimating the economic value of the potential reduction in occupational health impacts is that improvements in safety and health can bring economic benefits to workers, the companies they work for and to society more generally (through reduced spending on health care, for example).

Health economists have identified a series of potential economic impacts that can arise from ill-health. These are described briefly below in terms of those who may incur the impacts[6]:

- **Workers and their families**: financial costs, which consist of loss of earnings as a result of absence from work or the loss of a job and any extra expenditure required, for example on drugs or the need to attend hospitals; 'human costs' which relate to the loss of quality of life or of general welfare, and may include pain and suffering to the affected individual, and worry and grief caused to family and friends;

- **Employers**: loss of output; payments related to sick leave; administrative costs related to a worker's absence[7] including additional recruitment costs; loss of experience/expertise; overtime working; compensation payments (although this is usually covered by some form of employer's liability insurance); and insurance premiums; and

- **Taxpayers:** costs borne by taxpayers for national health care provision, disability and other social security benefits, etc. depending on national structure of social and health care provision[8].

From a welfare economics perspective, the total costs of occupational diseases are the sum of the impacts listed above for taxpayers, together with lost output (including productivity losses), gross wage and the non-wage labour costs of absent workers (such as loss of experience), administrative costs, loss of experience and the human costs. These represent the direct and indirect resource costs and the non-market 'external' costs of occupational diseases. The other costs listed above (e.g. insurance premiums) relate to what are commonly referred to as 'transfer payments' which do not give rise to net welfare effects. As a result, they are not considered in economic

6 Note that if this study were also considering accidents, a range of other costs would need to be considered including lost product and contaminated product costs, clean-up costs, and production delays.

7 Administrative costs as listed here is assumed to include clerical and management related costs. Legal costs may also be relevant where compensation payments are required in the case of disablement, for example.

8 Note that there will also be administrative costs associated payment of benefits and health care provision.

analyses, although they may be important in financial terms at the individual worker or employer level.

The remainder of this Section sets out the approach that has been adopted and economic valuation data that is used in this study to assess the benefits arising from the new EU Chemical Policy with regard to occupational diseases. As will be seen, it has been necessary to draw on the general health impacts assessment literature as few chemicals specific studies exist to provide readily usable data for the economic valuation exercise.

4.2 The Approach to Economic Valuation

4.2.1 Direct and Indirect Resource Costs

Many of the above impacts can be estimated using market-based information, for example, data on health care costs, lost output and employees' wages. For these impacts, the benefits of a change in policy are found using a 'cost of illness' approach which involves multiplying the medical costs and lost output per case of a given illness by the number of cases occurring 'with' and 'without' the proposed change in policy[9]. The difference between the two sums provides the estimate of the benefits delivered by the policy change. The approach is based on the use of observed data, i.e. costs, and on estimates of fatal/non fatal cases avoided.

The calculation requires data not only on the change in the number of cases of an illness but also on the average number of days of medical care. Data on the average number of days of medical care required per case or the average number of days that a worker with a particular illness is not at work are limited for many of the end-points of concern, requiring the use of average figures for other close end-points.

Other key issues in estimating the above include the absence of data on medical costs for particular end-points owing to the accounting practices adopted by health practitioners. In addition, there are added difficulties in estimating the resource costs associated with mortality effects. Of particular concern is the difficulty of establishing the boundaries between fatal and non-fatal cases in terms of hospital treatment costs. That is: are treatment costs for fatal illnesses significantly different from those for non-fatal cases? Or do costs relate solely to the number of days for in-patient treatment? Also, how many currently non-fatal cases may result in deaths in the future (in order to avoid double-counting)?

4.2.2 The Human (or External) Costs

The approach differs for the estimation of the 'human costs' of illness. Again, data are required on the number of cases occurring 'with' and 'without' the proposed policy, but market-based data do not exist for valuing losses in quality of life, pain and suffering, etc.

[9] See Pearce (2000) and NOHSC (1996) for a discussion of the cost of illness methodology.

There are essentially three approaches to estimating individuals' WTP for a reduction in the risk of morbidity or mortality (or, alternatively, their *willingness to accept* (WTA) an increase in risk):

- by examining the actual voluntary expenditures made by households on items that reduce the risk of death from certain activities, or by examining the costs associated with any avertive behaviour aimed at reducing risks;

- by examining the increased compensation individuals need, other things being equal, to work in occupations where the risk of death at work is higher (an estimate of the WTA compensation); and

- through the use of experimental markets and survey techniques to directly elicit individuals' WTP for a reduction in the risk of death.

Voluntary expenditure, for instance, would include the expenditure by a consumer on protective equipment – gloves, masks, etc. – prior to the use of a hazardous chemical (e.g. pesticides, wood treatment products) as this can be viewed as an indication of his/her willingness to pay to reduce the risks associated with the use of those products. However, the consumer expenditure approach also has several drawbacks with regard to its application in the context of chemical risks. A key problem relates to the fact that individuals' subjective views of the probability of a risk outcome occurring have been found to be highly different from scientific estimates of those probabilities. Their views are also likely to include not only the risk of death, but also the risk of illness (for example, associated with an accident or exposure which results in short-term effects). As a result, it may be difficult to separate out the two impacts, with this leading to double counting; it may also limit the degree to which valuations that are not chemical-specific can be used through benefit transfer approaches.

The wage-risk method relies on the assumption that there is enough labour mobility to permit individuals to choose their occupations so as to reflect all of their preferences, one of which is the preference for a level of risk and, thus, the level of compensation required to accept that risk (Postle *et al.*, 2002). However, this seems reasonably questionable for EU economies. In addition, in using these methods, it is difficult to distinguish between an individual's implied willingness to accept (WTA) compensation for risk of death as opposed to morbidity risks; and, while the estimates of WTA will depend on workers' perceptions of the probability of death, the studies usually adopt a statistical measure of the long-run frequency of death. It may also be the case that workers' perceptions of the probability of death are inaccurate, leading to the estimates being biased[10].

Techniques such as the Contingent Valuation (CV) method are used to develop direct estimates of an individual's WTP to avoid a particular health effect. These valuations are based on the creation of experimental markets and use surveys to elicit individuals' willingness to pay (WTP) to reduce the risk of death, of injury or of

[10] This issue has been explored for the chemical industry by Viscusi and O'Connor (1984), albeit with regard to injury risks and not fatality risks. The study found that workers in the industry perceived the risk of injury on the job to be 50 % higher than labour statistic estimates.

experiencing a particular illness. For example, the derivation of WTP with regard to deaths (mortality) is based on establishing what those who could be affected by a specified risk would be willing to pay for a small reduction in that risk (or improvements in safety), the resultant amount providing an estimate of the 'value of a statistical life' (VOSL). In the case of diseases (morbidity effects), people are asked how much they would be willing to pay to avoid certain symptoms or a day's illness. These survey methods can provide a valuation that incorporates not only benefits to the individual him/herself but also related to the protection of future generations (bequest values) and to knowing that others can benefit from a service (existence values).

Undertaking studies (such as a contingent valuation survey) specific to individual health end-points is a resource intensive exercise and can take many months to complete. As a result, researchers have turned to the use of existing data to provide an indicative measure of individuals' willingness to pay to avoid a particular type of health effect. This process is known as benefits transfer. Although the use of benefits transfer has been criticised[11], it has increasingly been used to provide insight into the economic gains that may result from the introduction of a new policy or a change in policy.

4.3 The Available Benefits Transfer Data

4.3.1 Direct Health Care Costs

Morbidity

Health care costs in the EU are given in Pearce (2000) for different Member States. These include both equipment and operating costs and are listed in Table 4.1 below. Although the figures are not specific to any particular type of illness, they provide a general indication of average health care costs. For the purposes of this assessment, therefore, they are assumed to provide a good order of magnitude indicator of direct medical costs.

In 2002, the UK Department of Health funded a programme of work on the unit costs of health and social care, which provides some figures on hospital costs for different types of patients. These figures have been derived by dividing the total expenditure in a given speciality by the number of works units provided (i.e. in-patient days, out-patient attendances). The resulting figures on the total net expenditure by service (excluding capital) are presented in Table 4.2.

[11] For example, some studies carried out in the past have found that: people may not have clear pre-formed preferences for non-market goods; difficulties in dealing with small changes and perceptions by respondents; the potential for biases; and possible insensitivity by respondents to the reduction in risk and different injury states.

Table 4.1: Average Health Care Service Costs in the EU by Country and Type of Care Assistance (€2000)		
Country	**Emergency Room Visit**	**Cost per Hospital In-Patient Day**
Belgium	-	315
France	33	433
Germany	28	417
Italy	23	-
Netherlands	45	367
Spain	132	-
United Kingdom	94	329
Source: Pearce (2000), based on Pearce et al. (1999)		

Table 4.2: Hospital Costs by Patient Group/Speciality (€2000)		
Patient Group/speciality	**Cost per inpatient day**	**Cost per outpatient attendance**
Cardiology	721	135
Dermatology	363	94
Medical Oncology	550	188
Neurology	426	201
Gastroenterology	401	130
Thoracic Medicine	378	164
Nephrology	481	146
Surgery	577	111
Accident & Emergency	486	118
Source: PSSRU (2002)		

In Sweden, the health care costs of cancer in 1991 were estimated at 6 billion SEK (around 0.81 billion ECU), of which 5 billion SEK was spent on hospital care (32% of total), 0.6 billion SEK on outpatient services (4%) and the remaining 0.2 billion SEK on drugs (1%). It is not clear, however, how these relate to the severity of cases.

Rough estimates have been prepared for Finland on the medical costs arising from chemicals related occupational health effects, with these suggesting that they were about €221 million in 2000 for 1,444 reported cases of occupational diseases due to exposure to chemicals (STM, pers. comm., 2003). This represents an average of around €153,000 per case (although costs will obviously vary greatly across end-points such as cancer and skin diseases). Medical costs account for about 47% of total costs. This suggests that the total costs are around €472 million, with the remainder attributed to absenteeism, disability payments, and deaths before age of retirement

More specific data on medical costs have been developed for asthma and other respiratory diseases. The UK National Asthma Campaign Audit 2001 estimated that the average total treatment costs per person with asthma are €173 (£108) per year, assuming that the person has not had an asthma attack in the last 12 months.

However, the costs increase for those who have experienced an asthma attack to €610 (£381) per person per year (2000 prices). A breakdown of these costs is shown in Table 4.3. As it is not possible to separate new cases from the number of new attacks amongst those already diagnosed, an approximate figure of €384 (£245) per asthmatic regardless of severity is suggested by the National Asthma Campaign (although health costs per case are known to increase according to how severe the person's asthma is and how many attacks they have experienced in the past).

Table 4.3: Costs of Treating Asthma per person by Occurrence and Health Service Category (€2000)

Heath Service Category	Had experienced an asthma attack in last 12 months	Had not experienced an asthma attack in last 12 months
Primary care (GP, nurse contact)	78	33
Hospital admissions, out-patient	317	19
Medication	201	117
Total (rounded)	597	169

*Source: National Asthma Campaign (2001): **Out in the Open, A True Picture of Asthma in the United Kingdom Today**, National Asthma Campaign Audit 2001. Special Supplement to the Asthma Journal, September 2001: 6(3)*

Estimates of the costs of hospital treatment for respiratory diseases more generally for the UK National Health Service (NHS) have also been produced. These relate to spells in hospitals by patients admitted as emergency admissions, with the main diagnosis being diseases of the respiratory system. For patients less than 65 years of age, an average cost per spell is around €1,200 (2000 prices), with the average length of stay being 3.9 days for this age group (Department of Health, 1999).

Mortality

A study in Sweden (Ramsberg *et al*, 1997) reports on the value of a statistical life implied by expenditure on a range of life-saving interventions. The costs are expressed in terms of the costs per life saved and the costs per life-year saved and include direct and indirect costs, where these include foregone earnings but exclude future health care and future non-health care costs[12]. 165 different interventions were examined, across nine different categories of lifesaving activities[13]. The mean cost per life saved was €45 million ($34.7 million) and the median €0.77 million ($0.6 million). The mean cost per life-year saved was €1.1 million ($863,000), while the median was €25,300 ($19,500). The implied number of life-years saved across all interventions is around 30 years.

Table 4.4 provides a list of costs for relevant health end-points as reported in the Swedish study.

12 Costs are discounted at 3%.

13 Nine different categories of lifesaving are analysed: medical care, radiation protection, road safety, life style risk, electrical safety, accidents, pollutants in the environment, fire protection and crime. Medical care is the one that includes by far the largest number of observations.

Table 4.4: Cost per Life-Year Saved for Lifesaving Interventions in Sweden (€2000)	
Intervention	**Cost per Life-Year Saved**
Lung Cancer Screening Program	454,000
Ambulance Service	15,600-91,100
Lung-cancer treatment program	73,000
Surgical treatment of oesophagus cancer	9,000
Source: Ramsberg & Sjoberg (1997): The Cost-Effectiveness of Lifesaving Interventions in Sweden, Risk Analysis, 17: 467-478.	

4.3.2 Indirect Resource Costs

Lost output arising from illness (morbidity) should be viewed as a cost to the economy although, as Pearce (2000) notes, who bears that cost will depend on how labour markets function. If absenteeism is rationally forecast by employers, wage rates or salaries should be set at lower rates than they otherwise would be in the absence of absenteeism, meaning that employees bear the majority of the costs. Where this is not the case, employers will bear the majority of costs.

It is estimated that in 1994, lost output in the UK summed to about £11 billion (€17.6 billion), with 177 million working days being lost (European Foundation, 1997). From these, however, only 20 million working days are estimated to be lost from work-related injury and illness. The direct and indirect costs, nevertheless, have been estimated at €840 (£525) per person per year[14].

It is not clear how many days off per employee the above figures relate to. The Chartered Institute of Personnel and Development (CIPD) reports around 10 working days off per employee for sickness in 2002. Applying this value to the 1997 figures provides a lower bound estimate of lost output of €84 (£52.5) per employee per day, with these costs including:

- occupational sick pay;
- statutory sick pay;
- replacement labour;
- overtime;
- reduced performance; and
- administration.

It is important to note that this is an average across all economic sectors, rather than being more specific to chemicals-related exposure. For the chemicals sector, the average number of days' illness is estimated at 9.8 days per year with a cost per employee per year of €705 (£441), i.e. €72 per day off work (other figures available by sector in CIPD, 2002).

In Sweden, lost output from cancer was estimated at 2.1 billion SEK (ECU, 1991 prices). Figures on the number of cases, however, are not available to enable a

[14] The CIPD reports a cost of £522 per employee per year (£2002).

calculation of the cost per employee (Swedish National Board of Health and Welfare, 1991).

In Denmark, it has been estimated that the working environment accounts for 15% of the total sickness among 15-66 years olds, and 20% if only sickness-related absence is considered: the socio-economic costs (including e.g. sickness-related absence costs, health care costs and early retirement costs) of work-related diseases and accidents in 1992 were estimated between 3 to 3.7 billion ECU (on a working population of 3 million persons). Costs were estimated at around 1,000 ECU per employee (1992 prices) (European Foundation for the Improvement of Living and Working Conditions, 1997). These figures, however, must either be adjusted for the fact that they include health care costs or be treated as total direct and indirect cost estimates.

An alternative approach to that given above is to base output losses on wage rates. This assumes that, on average, output is maintained despite an absence and that the cost of maintaining output is equal to the labour cost that is normally incurred in employing the absent worker. Thus, the overall costs of production are assumed to be unchanged.

This approach is particularly useful when also including estimates of the costs incurred by employees, although care is needed to avoid double counting when combining these estimates of the costs borne by employers with any willingness to pay values which may include lost earnings (see Navrud, 1997). Pearce (2000) provides estimates of per day output losses for the various EU countries based on wage costs to employers. These are presented in Table 4.5.

Table 4.5: EU Output Losses per day due to Absenteeism by EU Country (€2000 prices)

Country	**Cost (Euros)**
Belgium	-
Germany	75
Greece	20
Spain	50
France	-
Ireland	53
Italy	59
Luxembourg	132
Netherlands	67
Austria	-
Portugal	25
Finland	-
Sweden	59
UK	58
EU Average	**64**

Source: Pearce (2000): Valuing Risks to Life and Health, Paper prepared for the European Commission Workshop on Valuing Mortality and Morbidity

These estimates are averaged across all sectors of the economy and, therefore, should provide robust measures for considering illnesses from chemicals exposure in the workplace in general.

4.3.3 Human (External) Costs

Morbidity

The contingent valuation (CV) method has been used by a number of researchers to develop estimates of individuals' willingness to pay (WTP) to avoid morbidity related health effects and to reduce the risk of fatality.

Table 4.6 provides some examples of morbidity-related WTP values (Navrud, 1997) expressed in terms of WTP to avoid an additional symptom-day. These values were elicited in a CV survey carried out in Norway in 1996, as part of a project to value the damages caused by air pollution. It is of note though that air pollution was not mentioned as the cause of illness during the survey, as it was thought that this would distract respondents. As a result, it is argued that the results produced by the study are generally transferable to other policy contexts.

Table 4.6: Examples of Morbidity-Related WTP from Navrud (1997) per Day (€2000 prices)

Symptom	**WTP**
Through congestion	14
Eye itching	17
Coughing	14
Headache	25
Sinus congestion	27
Acute bronchitis	29
Shortness of breath	37
Asthma attacks (non-asthmatics)	80
Asthma attacks (asthmatics)	166

Source: Navrud (1997): Valuing Health Impacts from Air Pollution in Europe, Working Paper.

Another recent key study on morbidity is that by Pearce *et al* in 1999 (as referenced in Pearce, 2000). This study carried out CV surveys in Portugal, the Netherlands, Norway, Spain and the UK for health effects that were thought to be associated with air pollution. An explicit effort was made to test for the effects of *context* by eliciting values for health end-points without any reference to context, and repeating the exercise for the same end-points but with some contextual material added to the questionnaire.

Table 4.7 provides the central estimates by category. The categories relate to respiratory illness as this was the context of the study. Again, the valuations were designed to be 'context free', however, in the sense that the causes of the illness were not identified. Further analysis showed that the introduction of 'context' made no statistical difference to the estimates of WTP. In principle, then, these WTP estimates

could be transferred from one decision context to another[15]. The study concluded that *the transferability of the morbidity WTP estimates thus appears fairly safe in principle* (Pearce, 2000).

Table 4.7: Values for Morbidity in Europe: WTP to Avoid an Episode (€2000 prices)

Category	Country				
	Netherlands	**Norway**	**Portugal**	**Spain**	**UK**
Hospital admission for respiratory disease	453	482	480	682	262
Emergency room visit for asthma	205	382	296	234	210
3 days in bed with respiratory illness	114	190	141	181	133
One day persistent cough, with some breathing difficulties	45	58	45	62	32
One day with red, watering itchy eyes	6	50	112	85	22
One day with nausea and headache; patient unable to go to work	-	-	98	-	42

Source: Pearce (2000): Valuing Risks to Life and Health, Paper prepared for the European Commission Workshop on Valuing Mortality and Morbidity

The study also reports the values assumed in ExternE (1997) and Maddison (2000) and establishes a comparison, although the health categories considered are not identical in the studies[16]. The values from ExternE and Maddison are shown in Table 4.8 below. It is uncertain, however, why the ExternE value for the hospital category is so much higher than that of Pearce (and the reason is not given in the latter). However, owing to the fact that ExternE estimates rely heavily on US studies, it may be more appropriate to use the values from Pearce (2000) or the values from Maddison (2000).

15 The reliability of such a transfer exercise partly rests on whether all contexts are accounted for; the study tested for context in the contingent valuation surveys by adopting different questionnaires: one in which context was absent, and one in which the causal context was cited.

16 Despite hospital and casualty being the same, a respiratory bed day is taken to be the same as a restricted activity day in ExternE; however, the bed-day may be more restricted. 'Cough' and 'eyes' are minor restricted activity days and correspond to the ExternE minor restricted days. 'Stomach' is a day of work lost and does not have a direct counterpart in the ExternE study, so it is taken here to be a restricted activity day. 'Stomach' is also assumed to be equivalent to Maddison's restricted activity day. All of Maddison's values relate to an episode of one day's duration and are derived from a meta-analysis study that integrates the 'quality of well-being' with WTP estimates (Pearce, 2000).

Table 4.8: Values for Morbidity in Europe: Euros per Episode (€2000)		
Category/Valuation Study	**ExternE Values**	**Maddison**
Hospital admission for respiratory disease	7890	n/a
Emergency room visit for asthma	223	n/a
3 days in bed with respiratory illness	75	195
One day persistent cough, with some breathing difficulties	7.5	72
One day with red, watering itchy eyes	7.5	61
One day with nausea and headache; patient unable to go to work	75	121 (?)
Source: Pearce (2000): Valuing Risks to Life and Health, Paper prepared for the European Commission Workshop on Valuing Mortality and Morbidity		

In addition to the above morbidity estimates, Pearce (2000) reviews studies concerning WTP to avoid non-fatal cancers (with fatal cancers falling under the heading of mortality). The study discusses the estimates recommended by six different sources. It notes that the figures used in ExternE for Europe is derived from an unknown source and suggests that these are not reliable for benefit transfer purposes. Of the others, the most relevant to Europe is a study carried out in Italy that derived WTP values for avoiding lung cancer, prostate cancer and leukaemia (Aimola (1998) as reported in Pearce (2000)). The resulting figures are reported in Table 4.9. It should be noted, however, that this study only involved a small sample of the population of one city within Italy (Sicily).

Table 4.9: Willingness to Pay to Avoid Cancer Risk (€2000 prices)	
End-Point	**WTP per Case (€)**
Lung Cancer	50,000
Prostate Cancer	500,000
Leukaemia	730,000
Source: Pearce (2000): Valuing Risks to Life and Health, Paper prepared for the European Commission Workshop on Valuing Mortality and Morbidity	

Mortality

In 2000, DG Environment held a workshop for experts on the value of preventing a fatality. One of the outcomes of this workshop was the development of interim reference values for use in cost-benefit analyses. In particular, the estimates are to be used for the value of preventing a fatality in an environmental context where small reductions in risk occur over large populations. Given the interim nature of thte values and the caveats that surround much of the valuation literature, it is further recommended that ranges are adopted to provide a sensitivity analysis.

For the purposes of this assessment, the 'best' estimate and 'lower' estimate are assumed to be the most robust. The best estimate is based on the UK Government's figure for transport fatalities and will include some element of medical costs and of lost output as well as human costs. The lower estimate, however, reflects only

individuals' willingness to pay to reduce the risk of fatality (in other words it includes no medical or lost output costs). The estimates are (Enveco, 2001):

- lower estimate: €0.65 million (2000 prices); and
- best estimate: €1.0 million.

However, these two figure relate to environmental pollution more generally and, thus, deaths in a largely elderly population where the reduction in life expectancy is likely to be short. As a result, they need to be adjusted to reflect the fact that occupational cancers will affect a population with a more average age. Similarly, it is recommended that a cancer premium is added to the above values. This reflects the fact that people may be willing to pay more to reduce their risk of dying from cancer than to reduce their risk of a fatal heart attack (or accident fatality) because death from cancer may be preceded by a long period of serious illness. The premium, therefore, captures the period of ill health prior to death.

The adjustment for age involves multiplying the two estimates by 1.43 (to correct for the original age-adjustment factor of 0.7), while the adjustment for a cancer premium involves multiplying the estimate by 1.5 (implying a premium of 50% on top of the VOSL value). Applying these to factors results in lower and best estimates of:

- €1.39 million (2000 prices); and
- €2.14 million (2000 prices).

4.4 Linking Statistical End-Points with Monetary Data

The review of the literature presented above provides the basis for the economic assessment of potential changes in health impacts under REACH. Based on the information presented above, the figures presented in Table 4.10 have been adopted as the costs arising from the types of diseases falling under each of the end-points.

Table 4.10: Cost Assumptions Used in this Assessment (€2000)

End-Point	Medical Costs (per case)	Lost Output (per day)	Human Costs (per day)	Days per Case	Total per Case per Year (€) (rounded)
Skin Diseases	€94	€64	€14	7	€640
Respiratory Disease	€170 per year	€64	€80	7	€1,180
Eye Disorders	€35	€64	€17	7	€600
CNS Diseases	€4375	€64	€450	14	€11,570
Cancer (Deaths only)			€1.39 million (lower) €2.14 million (upper)	n/a	.39 million (lower) €2.14 million (upper)
Poisonings	€0	€64	€75	1	€140

For all end-points, the average number of days per case has been based on figures developed by HSE (1999c). The figure of seven relates specifically to lower

respiratory diseases, with seven also being the average for 'other' diseases, where this includes for example skin diseases, headaches and eyestrain, amongst others. It has been assumed that a CNS disease results in an average loss of 14 days per case, with this being the average figure quoted by HSE across all occupational illnesses.

For some of the end-points of concern here, such as asthma and CNS diseases, the assumption that a case lasts only a fixed period of time may lead to an underestimate of costs. In particular, medical costs may be significantly higher than those given above, as may be lost output and human costs. The figure for lost output reflects only absences and fails to account for any reductions in worker productivity that may arise from chronic morbidity effects. Although WTP is likely to decline as the number of days' illness increases, it may also vary between diseases that last only a few days and those that are more chronic in nature.

The following key assumptions underlie the figures presented in Table 4.10:

- **Skin diseases:** medical costs are based on average costs per dermatology outpatient from Table 4.2. Lost output is based on the average EU figure quoted in Table 4.5. Human costs are based on the lowest WTP figure from Table 4.6, with this likely to represent an underestimate.

- **Respiratory Diseases:** the figures adopted relate to asthma and, thus, will represent underestimates of the costs associated with some other forms of respiratory disease. Medical costs are based on the total costs for a person who had not experienced asthma in the last 12 months from Table 4.3. Lost output is taken from Table 4.5. Human costs are based on the WTP estimate derived by Navrud and reported in Table 4.6, with this being a conservative assumption given the higher figures quoted in Tables 4.7 and 4.8.

- **Eye Disorders:** the medical costs for eye disorders are based on the costs of an emergency room visit or primary care from Tables 4.1 and 4.3. Lost output is taken from Table 4.5 and human costs are taken from Table 4.6.

- **CNS Diseases:** in this case it has been assumed that 7 days of hospitalization is required on average across all cases, with the costs per hospital day based on the figure for neurology quoted in Table 4.2; a further 7 days of outpatient attendance is assumed. Lost output is taken from Table 4.5. The figure of €450 as reflecting the WTP to avoid a case of disease is based on the figures given in Table 4.7 as to the WTP to avoid hospital admission for respiratory disease; the reliability of this assumption is unknown.

- **Cancer:** DG Environments' interim values of a statistical life (VOSL) provide the lower and upper bound figures for individuals' WTP to avoid a future cancer death. Estimates for the VOSL environmental pollution have been adjusted to reflect a more typical age range and a premium to avoid the period of illness prior to death associated with cancer.

It is also important to note that the cost assumptions being adopted here will result in an underestimate of the true health costs avoided per case of occupational disease. In

particular, the following elements out of the total costs of occupational illnesses are not included in the above figures:

- the costs to employers associated with reduced productivity of those suffering from chronic illnesses;
- administrative, management and legal costs incurred by employers;
- loss of expertise and experience, where workers suffer disablement;
- the direct costs to workers of purchasing medicines (with the exception of asthma) or of traveling to visit doctors/hospitals; and
- Government expenditure on illness and disability benefits and the administration of these schemes.

5. ESTIMATED VALUE OF PREDICTED REDUCTIONS IN HEALTH IMPACTS UNDER REACH

5.1 Timing of Health Impact Reductions

Sections 3 and 4 set out the scenarios for the occupational disease reductions assumed to take place as a result of REACH and the economic valuation data that has been used to estimate the value of these reductions. The data have been combined to calculate upper and lower bound estimates of the economic value of the potential occupational disease costs avoided.

The first step in calculating the economic value of the disease costs avoided is to calculate what these costs are on a per annum basis. In order to do this, assumptions have to be made as to when reductions in occupational diseases will take place and what level of reduction will be achieved per annum.

Table 5.1 below sets out the timetable for the testing and registration of chemicals under REACH. As can be seen from this table, the original timetable proposed that data provision would be completed within 10 years following adoption of the White Paper. No specific details were given as to when authorisation of substances has to be completed (although one might assume that this could extend beyond the 10 year period as some substances may not be confirmed as requiring authorisation until late in the overall timetable).

Table 5.1: Timetable for Testing and Registration under REACH

Tonnage	Testing Data and Years from Implementation		Total Estimated Number of Chemicals*
< 10 t/y	• All data	2012 (10 years)	20,000 Existing 9.500 Intermediates
< 100 t/y	• Base set	2012 (10 years)	5,300 Existing 11,500 Intermediates
< 1000 t/y	• Base set • Level 1	2008 (6 years) 2012 (10 years)	2,500 Existing 5,000 Intermediates
> 1000 t/y	• Base set • Level 2	2005 (3 years) 2010 (8 years)	2,465 Existing 16,500 Intermediates

* Based on Scenario 2 as developed for the Business Impact Assessment (RPA, 2002)

Table 5.1 also sets out the number of existing chemicals and intermediates that fall within each of the production bands, and highlights the dates by which testing has to be completed for substances produced in the different tonnage bands. As can be seen from the table, around 5,000 of the estimated 30,000 existing substances are expected to be produced at greater than 1000 tonnes per year (t/y). Based on statistics concerning actual test requirements, it was calculated for the Business Impact Assessment (RPA and Statistics Sweden, 2002) calculated that around 1,100 of these higher volume substances would go through human health specific Level 1 testing. Over 550 of these would then go to Level 2 testing (for the medium test requirements and medium number of chemicals assumptions – Scenario 2). One might expect that a significant proportion of such further testing would be in response to concerns over a substance being a potential CMR. Although reduced test requirements are proposed

for the lower tonnage chemicals, even the *in vitro* tests required for under 10 t/y should signal potential mutagenic effects (with these then providing an indicator of potential concerns over carcinogenicity).

It is important, therefore, for the reduction in health impacts to be linked to when test data are required to be produced. As indicated in Table 5.1, for substances produced at over 100 tonnes per year, base set data are to be available within 3 to 6 years and higher level test data within 8 to 10 years. For the lower production volume substances, base set data is required within 10 years. This suggests that it is likely that most health impact reductions will not occur until near to or after the end of the 10-year time period.

In order to capture the lag time between when test data becomes available and when reductions in occupational diseases begin to occur, a 30-year time horizon has been assumed for this assessment. This allows assumptions to be made as to the number of cases of disease reduced in each year, up to the point where the total reduction assumed for each scenario is achieved.

As discussed in Section 3, the reduction in health effects is expected to arise from two key sources: the provision of additional data on the toxic effects of chemicals as part of the registration of existing chemicals; and the authorisation of newly identified CMRs. Thus, for some of the health end-points being considered in this assessment, benefits may be realised as soon as base set data are available. This will be almost immediately for a proportion of chemicals, and will then continue over the 10 year time period for testing and registration. For other end-points, and in particular cancer, there will be a further lag time before reductions are realised. For example, it may take up to 20 years after a carcinogen has been identified for reductions in associated deaths to be realised, owing to the long latency of some forms of the disease.

To try and reflect these differences, we have made assumptions for each of the health end-points as to the proportion of occupational diseases that will be avoided each year over the 30 year time period. These are reported in Table 5.2. The second column of this table indicates the year in which we expect the first reductions in health impacts to start. So, for example, it is assumed that after six years of testing and registration activities, action will be taken to reduce exposure to chemicals that may give rise to occupational skin diseases, respiratory diseases, and eye disorders. It is assumed that a higher level of test data is required to identify those substances that may be causing CNS diseases and cancer related deaths. As a result, reductions in the number of these diseases do not occur until after eight and 10 years respectively.

The third column in the table then indicates what percentage of the total number of cases related to exposure to non-specific or unknown substances is assumed to be reduced each year. Thus, for skin diseases and eye disorders, it is assumed that 20% of the cases are reduced each year, thus taking five years for the full number of cases avoided to be realised (column four). Lower per annum reductions in the number of cases are assumed for the other end-points, with only 5% of deaths assumed to be reduced per year for cancer (thus taking 20 years for the total number of deaths to be avoided).

Table 5.2: Assumptions on Timing of Health Impact Reductions				
End-Point	**Year Reductions in Cases Start**	**% of Cases Reduced Per Annum**	**Number of Years to Achieve Reductions**	**Year Scenario Reductions Realised**
Skin Disease	6	20	5	11
Respiratory Disease	6	12.5	8	14
Eye Disorders	6	20	5	11
CNS Diseases	8	12.5	8	14
Cancer Deaths	10	5	20	30

The final column in Table 5.2 indicates in what year of the 30 year time horizon the full reduction in number of cases of disease is assumed to occur for each of the end-points (with the full reductions being the number of cases indicated for each scenario in Table 3.4). So, for example, it is only in year 30 that the full 2,167 or 4,333 cancer deaths per year are avoided. Up to this point in time, less than the full number is avoided[17].

5.2 Calculated Value of Occupational Disease Reductions

The figures given in Table 5.2 on the percentage of cases reduced per annum are then combined with the economic costs of diseases for each of the end-points (presented in Table 4.10), and the data presented in Table 3.4 on the number of cases for each health impact scenario, to calculate the benefits arising from increased information provision of authorisation under REACH. The resulting present value estimates of the economic value of the future reduction in health impacts are summarised in Table 5.3 (calculated over the 30 year time period and at a 3% discount rate, with this rate being used for consistency with the Business Impact Assessment).

Table 5.3: Discounted Value of Health Impact Reductions (€1 million, 2000 prices, discounted over 30 years at 3%)		
End-Point	**Lower Bound Number of Cases**	**Upper Bound Number of Cases**
Skin Disease	11.6	102.9
Respiratory Disease	4.0	53.5
Eye Disorders	0.4	0.4
CNS Diseases	7.1	68.8
Cancer Deaths (using low VOSL value)	17,591.6	35,183.1
Cancer Deaths (using best VOSL value)	27,083.4	54,166.8
Total Excluding Cancer	23	225
Total Including Cancer (low VOSL)	17,615	35,408
Total Including Cancer (best VOSL)	27,106	54,392
Note: Rounding may affect column sums		

[17] For example, for cancer it is assumed that 5% of deaths are avoided in year 10, 10% are avoided in year 11, 15% in year 12, and so forth until 100% of those assumed for either the lower or upper bound scenario are avoided in years 29 and 30.

As can be seen from Table 5.3, the present value of the estimated occupational disease reductions arising from REACH ranges from almost €18 billion to €27 billion for the lower bound assumptions on the number of cases that will be reduced through increased test data and authorisation. The present value figure of €18 billion relates to the lower figure for the value of a statistical life (VOSL) assumed for cancer deaths. The higher figure of € 27 billion relates to the 'best estimate' VOSL, adjusted as recommended by the Commission.

There is obviously uncertainty surrounding these estimates. This includes uncertainty as to the actual number of cases of each of the diseases that will be reduced as a result of REACH and the economic value of those reductions.

Non-Cancer End-Points

As Section 3 indicated, the lower bound estimates have been developed so as to reflect to the degree possible the number of cases of disease arising from exposure to unknown chemicals, rather than to exposure to non-specific chemicals which provides the basis for the upper bound. However, the upper bound figures may also be conservative. For example, surveys carried out in the UK have suggested that a far higher number of skin diseases cases occur each year than is reported. Furthermore, as discussed in Section 3, many of the estimates relate to disablement cases and thus may fail to include illnesses that result in a short periods of absence but not in compensation claims.

The above estimates for the non-cancer end-points also assume that the number of cases of occupational diseases from unspecific or unknown chemicals effectively reduces to zero as a result of REACH. This is probably over-optimistic as cases of disease are likely to continue, albeit at significantly reduced incidence rates (and in some cases at close to zero once action has been taken in the workplace to reduce exposure).

Although the estimated benefits of avoiding future cancer deaths related to occupational chemical exposure are much greater than those associated with the avoidance of the other occupational diseases, the benefits of reducing these other diseases may still be significant. In particular, for the upper bound number of cases, the estimated value of reducing the number of occupational skin diseases is over €100 million and the value of reduced respiratory disease is over €53 million. There is obviously uncertainty as to whether REACH would actually deliver these numbers of reduced health impacts; however, this is off-set to some degree by the fact that not all of the economic costs associated with the incidence of such diseases have included within the above estimates.

Cancer End-Points

For cancer, the lower bound figure assumes that only 6.7% of the estimated occupational cancers in the EU are avoided in the future (with this figure corresponding to 0.23% of total cancer deaths within the EU). These lower bound figures will therefore be the most robust. In addition, we believe that the figures adopted here with regard to the predicted number of cases of cancer that would be

reduced is conservative. This is because we have assumed that only one third of the annual cancers deaths that may result from exposure to unknown carcinogens will be reduced as a result of REACH and subsequent actions taken by industry and Competent Authorities to control exposure to carcinogens.

The economic value of avoiding future cancer deaths accounts for over 99% of the total economic value of the future health impacts avoided. Again, this is unsurprising given the relative monetary values attached to the avoidance of the risk of death from cancer compared with any of the morbidity end-points.

5.3 Sensitivity of Estimates

The above estimates have been based upon a series of assumptions as to the number of occupational disease cases that will be avoided in future years, the economic costs avoided through the reduction in the number of cases and the timing of those reductions. The discussion presented above highlights the sensitivity of the analysis results to the key assumptions, particularly the value attached to avoidance of cancer deaths and the number of cases avoided.

In particular, it is important to note that it has not been possible within this study to estimate the number of cases of occupational disease for each of the end-points that would be reduced in the absence of REACH. One would expect current legislation to have an on-going impact on the levels of occupational disease across the EU. However, as argued in Section 2, the lack of available information on the majority of existing chemicals (and intermediates) may constrain the effectiveness of current legislation. We have tried to account for the impact that current legislation may have in the future by considering scenarios related to both non-specific and unknown chemical agents and, in the case of cancer, by assuming that only a percentage of the estimated number of cases arising from unknown chemical carcinogens will be reduced.

There is considerable uncertainty as to the number of cancer deaths that might be avoided in the future owing to REACH. One might argue that the lower and upper bound assumptions adopted here are either too low or too high. Either may be the case, and further research would be required to establish a reliable estimate. However, it should be recognised that only deaths have been considered here. No allowance has been made for the economic costs associated with cancer survival, where this will include medical treatment, lost output and human costs. For some of the end-points (such as bladder cancer), a larger proportion of those developing cancer may survive than die.

It should also be noted that the results will be somewhat sensitive to the assumptions on the timing of when benefits are realised in terms of reduced cases. To be conservative, it has been assumed here that no benefits arise for the first six years following implementation of REACH for the morbidity end-points and for the first 10 years for the cancer death end-points. Changes to the assumptions as to the percentage reduction of cases that would arise per year may have a significant effect on the above estimates.

The approach adopted here, and in particular the failure to account for some of the economic costs arising from occupational disease impacts, will result in an underestimate of the true economic costs (see Section 4.4). It is difficult to say how significant an underestimate the above figures may represent. As an illustrative example, however, it is estimated that 12% of total economic costs of work-related accidents and illnesses in the UK (HSE, 1999c) are associated with administration. Rough estimates for Finland suggest that disability payments alone may account for around 23% of the total costs of occupational illnesses associated with exposure to chemicals (STM, pers. comm., 2003).

Finally, the health impact reductions and associated economic benefits will not be delivered by REACH alone. For them to be realised, additional actions would need to be taken by the Commission and Competent Authorities in regulating the use of the chemicals, and by manufacturers, downstream users and consumers of chemicals. One might expect such actions to cover the full range of potential risk management measures, such as:

- improved labelling;
- the establishment of occupational exposure limits;
- increase in or changes in use of personal protective equipment;
- installation of new emissions control methods;
- reformulation and chemical substitution;
- changes in processing methods or in product characteristics;
- bans on the use of some substances in certain downstream and consumer uses and/or products; and
- total bans on the use of particular substances.

The costs of adopting such actions will vary across chemicals and applications. In some cases, the costs of appropriate action may be insignificant, while in others the costs of managing health risks will be much higher.

6. SUMMARY AND CONCLUSIONS

6.1 Aims and Approach

Previous work on the implications of the New Chemicals Policy has focused on the direct, and to a lesser degree, indirect impacts on businesses of implementing REACH. The environmental and worker health and safety benefits that may arise from the implementation of REACH were not considered.

The aim of this study as been to provide an assessment of the potential reduction in occupational health impacts that may arise at the EU level from the increased availability of data on chemical properties and authorisation under of CMR substances under REACH. This includes consideration of impacts on both the health of workers within the chemical industry and downstream users of chemicals.

The approach that has been taken in assessing the potential health risk reductions has involved:

- examining the degree to which REACH may lead to further reductions in occupational health related diseases given the existing legislative framework;
- reviewing existing data on the numbers of cases of chemical exposure-related occupational health impacts at the Member State and EU level, and determining the number attributable to non-specific and unknown chemicals;
- reviewing the literature on the financial and economic costs of occupational illnesses;
- developing scenarios as to the estimated number of future health impacts avoided;
- setting out assumptions as to the timing of health impact reductions following implementation of REACH; and
- calculating the economic value of the future health impacts avoided.

This study has not included an extensive consultation exercise. Instead we have relied upon published data produced by Member State Health and Safety Bodies, Eurostat, Trade Organisations and Labour Organisations. These data have been added to by a range of government and academic sources. The data are not considered to be comprehensive but should be appropriate to providing an indication of the potential benefits of REACH in relation to reductions in chemicals exposure related occupational diseases.

6.2 Expected Role of REACH in Reducing Occupational Diseases

There is a wide array of legislation providing protection to workers against the occupational diseases that may arise from exposure to chemicals. Much of this has been introduced in the past few years and is expressly aimed at reducing occupational health impacts. However, because some of this legislation is yet to come into full force, the impact that it will have on the number of cases of different health impacts arising across the European Union workforce is unclear. This is particularly true for occupational cancers arising from exposures to chemicals. The impact that the recent

Directives will have on future rates of occupational exposure related cancer has not been quantified. As a result, there is uncertainty surrounding the number of occupational cancers that will be reduced as a result of these recently introduced Directives.

In addition, for health end-points such as cancer, there may be more than one causal factor leading to the development of the disease; thus, exposure to chemicals may be the main factor leading the development of cancer, or may be a contributing factor together with other environmental and socio-economic factors. This leads to uncertainties as to the number of cancers (and other diseases) that may be reduced through the targeting of chemical agents known to be leading to a particular disease and those not currently known to owing to their being less information available on their properties.

A key factor affecting the ability of the current worker safety legislation to deliver the desired reduction in health impacts, however, is that the legislation relies on the availability of data on human health risks for its effectiveness. Where such data are not available for chemicals being used in the workplace, the ability of the legislation to achieve its goals is limited. Given that the necessary data are unavailable for most chemicals currently placed on the market or used as intermediates, the effectiveness of many of the Directives is currently being restricted.

In the White Paper Strategy for a Future Chemicals Policy (Com (2001) 88 final), the provision of new and additional data on the health risks arising from chemicals whose properties are currently poorly understood was expected to result in the identification of 500 new carcinogenic, mutagenic and reproductive toxic (CMR) substances. Whether this or a lesser number of CMRs is identified, the continued use of such substances under REACH would have to be authorised, with socio-economic justifications provided for use in specific applications. The result of the identification and authorisation of currently unknown CMRs is assumed to be a reduction in the incidence of work-related cancers in the future, with corresponding reductions not only the number of deaths arising from cancer, but also the financial and economic costs associated with cancer treatment and recovery (for those who survive a case of cancer).

6.3 Health Impact Scenarios

The analysis carried out here has focused on assessing future health impact reductions for the following occupational health end-points:

- skin diseases;
- respiratory diseases;
- eye disorders;
- central nervous system diseases; and
- cancer (covering 16 different types of cancer deaths).

For each of these end-points, estimates were developed of the number of cases that may be avoided in the future owing to the increased availability of information on

health risks and to the authorisation of currently unknown CMRs. Statistical data on occupational diseases in general were used to identify the following sets of chemicals related diseases:

- the total number of diseases caused by exposure to chemicals;
- the number of diseases caused by exposure to specific chemicals (such as isocyanates);
- the number of diseases classified as being caused by exposure to 'non-specific' chemicals; and
- the number of diseases classified as being caused by exposure to 'unknown' chemicals.

Through extrapolation of country data, estimates were developed on the number of cases of diseases for the various end-points caused by exposure to non-specific or unknown chemicals. Table 6.1 summarises the scenarios that act as the basis for the assessment. The lower bound figures relate to exposure to unknown chemicals while the upper bound relates to exposure to non-specific chemicals.

The exception to this approach is for cancers, where mortality data for men and women for 16 different end-points were combined with estimates of the percentage of cancer deaths for each of those end-points to result from occupational exposure to chemicals. From a total figure for chemicals exposure related occupational cancer deaths per year in the EU, an estimate of 20% of these was adopted as resulting from exposure to unknown chemical carcinogens. It was then assumed that one third and two thirds of these deaths per year would be avoided in the future, to provide the lower and upper bound scenarios.

More generally, these two scenarios reflect the uncertainty surrounding the actual impact that additional information provision and authorisation under REACH will have on chemicals related occupational diseases.

Table 6.1: Occupational Disease Impact Scenarios on the Number of Cases Reduced Under REACH

Health End-Point	Cases Associated with Exposure to Unknown Chemicals – LOWER BOUND	Cases Associated with Exposure to Non-Specific Chemicals - UPPER BOUND
Skin Diseases	**1,350**	**12,000**
Respiratory Diseases	**275**	**3,680**
Eye Disorders	**50**	**50**
CNS Diseases	**50**	**485**
Cancers	**2,167**	**4,333**

6.4 The Economic Costs

The above figures were then combined with estimates of the economic costs associated with diseases under each of the end-points, where these costs include:

- costs of medical treatment;

- the value of lost output;
- human costs, where these reflect an individual's willingness to pay to avoid a particular health effect.

In the case of cancer, lower and upper bound valuations were adopted, with both of these being based on recommended figures for the value of preventing a fatality in cost-benefit analyses carried out for or by DG Environment. Both the lower and upper bound figure represent individuals' willingness to pay to avoid the risk of death (with this being the value of a statistical life). Both the lower and upper bound estimates have been adjusted to reflect the age of those at risk and the fact that there is a period of ill health prior to death associated with cancer (a cancer premium). These adjustments have been made following the recommendations set out in DG Environment's guidance on how to apply such values.

The figures presented in Table 6.2 were adopted as the costs arising from the types of diseases falling under each of the end-points.

Table 6.2: Cost Assumptions Used in this Assessment (€2000)

End-Point	**Medical Costs (per case)**	**Lost Output (per day)**	**Human Costs (per day)**	**Days per Case**	**Total per Case per Year (€)** (rounded)
Skin Diseases	€94	€64	€14	7	€640
Respiratory Disease	€170 per year	€64	€80	7	€1,180
Eye Disorders	€35	€64	€17	7	€600
CNS Diseases	€4375	€64	€450	14	€11,570
Cancer (Deaths only)			€1.39 million (lower) €2.14 million (upper)	n/a	€1.39 million (lower) €2.14 million (upper)

6.5 The Results

The results of the analysis are presented in Table 6.3. The figures presented here assume that the benefits are realised over a 30 year time period, with the time when reductions in diseases begins to occur linked to the nature of the end-point. The number of cases avoided in a given year (over the 30 year time period) also varies across end-points, with the number of cases avoided accumulating over time. Note that a 3% discount rate has been assumed for consistency with the Business Impact Assessment carried out for REACH (RPA and Statistics Sweden, 2002).

As can be seen from Table 6.3, the present value of the estimated health impact reductions arising from REACH range from around €18 billion to €27 billion for the lower bound assumptions on the number of cases that will be reduced through increased test data and authorisation. The present value figure of almost €18 billion relates to the lower figure for the value of a statistical life assumed for cancer deaths. The higher figure of € 27 billion relates to the 'best estimate' VOSL adjusted as recommended by the Commission.

Table 6.3: Discounted Value of Health Impact Reductions (€1 million, 2000 prices, discounted over 30 years at 3%)		
End-Point	**Value of Lower Bound Number of Cases**	**Value of Upper Bound Number of Cases**
Skin Disease	11.6	102.9
Respiratory Disease	4.0	53.5
Eye Disorders	0.4	0.4
CNS Diseases	7.1	68.8
Cancer Deaths (using low VOSL value)	17,591.6	35,183.1
Cancer Deaths (using best VOSL value)	27,083.4	54,166.8
Total Excluding Cancer	23	225
Total Including Cancer (low VOSL)	17,615	35,408
Total Including Cancer (best VOSL)	27,106	54,392
Note: Rounding may affect column sums		

The above estimates assume that number of cases of diseases for the non-cancer end-points related to unspecific or unknown chemicals is effectively reduced to zero. This is over-optimistic as cases of disease will continue, albeit one would expect incidence rates to reduce significantly (and in some cases they should fall close to zero once action has been taken in the workplace to reduce exposure). This will be off-set, however, by the fact that not all of the economic costs have been taken into account.

For the cancer end-points, the figures adopted here as to the predicted number of cases of cancer that would be reduced is more pessimistic. For the lower bound figure, we have assumed that only 0.23% of total annual cancers deaths in the EU are associated with exposure to unknown chemical carcinogens in the workplace and, thus, could potentially be avoided as a result of more data being available on chemical properties through REACH. In addition, the estimates of costs avoided for cancer relate only to individuals' willingness to pay to avoid the risk of death. They take no account of the medical costs associated with the diagnosis and treatment of the cancers prior to death. Nor do the above estimates take into account the human costs associated with those who develop but survive a case of cancer.

The estimated benefits of avoiding future cancer deaths are much greater than those associated with the avoidance of the other end-points. This does not mean, however, that the benefits of reducing these other diseases would not be significant. In particular, for the upper bound number of cases, the estimated value of reducing the number of occupational skin diseases is over €100 million and the value of reduced respiratory disease is over €53 million.

There is obviously uncertainty surrounding these estimates. This includes uncertainty as to the actual number of cases for each of the diseases that will be reduced as a result of REACH and the economic value of those reductions. Furthermore, not all of the economic costs associated with occupational diseases have been accounted for within the above estimates. This is particularly true in the case of cancer, as the costs incurred in relation to survival of a case of cancer are not taken into account (where these would include medical costs, lost output and human costs).

6.6 Conclusions

The economic value of the health impact reductions that may arise from REACH are significant. This is true whether one adopts the lower or upper bound scenarios as to the number of future cases of occupational diseases avoided and the economic value of avoiding those diseases. Although the estimates vary widely, depending on what set of assumptions are adopted, all of the estimates point to considerable future savings in health care costs, lost output and 'human' costs.

It should also be noted that the above figures may represent underestimates of the full economic value of reductions in occupational diseases. In particular, the approach adopted in producing the above figures does not take into account the following resource and social costs:

- the costs to employers associated with reduced productivity of those suffering from chronic illnesses;
- administrative, management and legal costs incurred by employers;
- loss of expertise and experience, where workers suffer disablement;
- the direct costs to workers of purchasing medicines (with the exception of asthma) or of traveling to visit doctors/hospitals; and
- Government expenditure on sick pay and disability benefits and the administration of these schemes.

Offsetting these further benefits, however, is the fact that REACH alone will not deliver the reductions in health impacts. Achieving these benefits will require that actions are taken by the European Commission and Competent Authorities, as well as by manufacturers, downstream users and consumers of chemicals. This report does not address the costs of undertaking such measures, where these may include additional controls, chemical substitution, changes in processing methods, etc. Thus, the full costs of delivering the economic benefits calculated above are greater than those of implementing REACH alone.

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ANNEX 1

AVAILABLE SOURCES OF STATISTICAL INFORMATION

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Table A.1: Available Statistical Data to Date (3 February 2003)				
Country	***Year***	***Type of Data***	***Lang***	***Source***
Occupational Injuries-Diseases-Deaths				
A. Chemicals-specific Statistics				
World	1998	Percentages of global cancer deaths due to exposure to chemicals at the workplace (based on an Australian study by Morrell et al.)	EN	ILO, 2000
EU	1995	Number of occupational diseases by economic activity and disease (diseases caused by different chemicals)	EN	Eurostat, 2002a
EU	1990-1993	CAREX Database: exposures of EU workers to chemicals (removal of irrelevant carcinogens, division by factor 1.3)	EN	Finnish Institute of Occupational Health, 1998
EU		Number of deaths (cancer, lung, skin, asthma) that are due to chemical exposure on the basis of general population deaths (Australian study)	EN	ILO, 2002
EU	2000	3rd European Survey of Working Conditions: Self-reporting percentage of workers handling hazardous substances and inhaling vapours, fumes, etc.	EN	European Foundation for the Improvement of Living and Working Conditions, 2001
Austria	2001	Occupational accidents and diseases due to exposure to chemicals at the workplace	EN	BMWA, 2002
Austria	2000	Occupational accidents, diseases and deaths related to chemicals	GE	EU OSHA website
Belgium	2001	Occupational illnesses statistics (Annual Report)	FR	FMP FBZ, 2002
Denmark	2000-2001	Occupational diseases and accidents related to exposure to chemicals at the workplace	EN	Danish OEA, 2003
Finland	2000-2001	Occupational diseases due to exposure to chemical at the workplace for the years 2000-2001	EN	STM, 2003
Finland	1999	Occupational diseases due to chemicals (skin diseases, allergic respiratory diseases, cancer)	EN	Finnish Institute of Occupational Health, 2001
France	2000	Number of occupational diseases by causative agent	FR	CNAMTS, 2002
Germany	2001	Number of occupational skin diseases, lung diseases and cancer related to exposure to chemicals in Germany	EN	Zober, 2002
Germany	2001	Number of occupational accidents due to Chemical Exposure	EN	HVBG, 2002
Germany	2001	Number of occupational diseases and deaths due to chemical exposure	EN	HVBG, 2002
Germany	2000	Numbers of suspected occupational illnesses, recognised occupational illnesses and new pensions from occupational illnesses by type of diseases for the years 1998-2000 (includes non chemical-specific illnesses)	GE	Deutscher Bundestag, 2002
Italy	1990-1999	Number of occupational diseases by type of chemical	IT	ISPESL, 1999
Spain	1997	Percentage of workers handling or touching chemicals (self-reporting survey)	EN	EU OSHA-website

Spain	2001	Number of occupational accidents (of variable severity) and diseases due to chemical exposure	EN	MTAS, 2002
Sweden	2000-2001	Number of occupational accidents and diseases due to exposure to chemical/biological agents	EN	ISA, 2002
Sweden	1999	Number of occupational accidents and diseases due to exposure to chemical/biological agents	EN	SWEA, 2001
UK	2000 & 2001	Number of occupational injuries (fatal, non-fatal major) from exposure to harmful substances	EN	HSE, 2001a
UK	1995	Number of (self-reported) new occupational asthma cases due to breathing respiratory sensitisers	EN	HSE, 1999a
UK	1995	Number of (self-reported) occupational asthma sufferers (list of sensitisers is provided)	EN	HSE, 1999a
UK	1995	Number of (self-reported) occupational skin diseases due to exposure to substances and total working days lost	EN	HSE, 1999a
UK	1995	Number of people exposed to industrial solvents at work: >7,000,000	EN	HSE, 1999a
UK	1999	Meredith and Nordman (1996) estimate that in total 2 per cent of adult asthma might have been caused at work. A further 4 per cent of adults are estimated to have had their asthma aggravated by their work (National asthma Audit 1999/2000)	EN	National Asthma Campaign, 2001
B. General Occupational Statistics (not chemicals-specific)				
World	2000	Number of global occupational deaths and percentages of cancer, circulatory diseases, accidents, communicable diseases (asbestos 100,000)	EN	ILO, 2002
Established Market Economies (EU, USA, AUS) and Former Socialist Europe	1999	Occupational disease rates (estimates)	EN	Leigh *et al*., 1999
EU	1995	Number of occupational diseases by diagnosis groups and sex	EN	Eurostat, 2002a
EU	1995	Number of occupational diseases by diagnosis groups and age	EN	Eurostat, 2002a
EU	1999	Work-related health problems during the past 12 months by sex in each Member State	EN	Eurostat, 2002a
EU	1999	Standardised occupational accident incidence rates by country	EN	Eurostat, 2002a
EU	1999	Standardised prevalence rate of work-related health problems by severity, diagnosis group, economic activity of the employer and age	EN	Eurostat, 2002a
EU	1998/99	Number of fatal occupational accidents	EN	Eurostat, 2001a
EU	1998-1999	Work-related health problems	EN	Eurostat, 2001b
EU	1998/99	Accidents at work	EN	Eurostat, 2001a
France	1998	Number of occupational eczema cases	FR	EU OSHA website
Greece	1938-1997	Occupational Accidents and Deaths	GR	ELINYAE, 2003
Ireland	2001	Reported benefits claims for occupational eczema/dermatitis	EN	EU OSHA website
Ireland	2001	Number of occupational accidents	EN	HSA, 2002

Netherlands	1998 & 1999	Reported Occupational diseases (skin complaints, lung complaints, chronic toxic encephalopathy)	EN	NCvB, 1999
Portugal	1990-1997	Occupational permanent disability (poisoning, dermatosis, pneumatosis)	EN	EU OSHA website
UK	1994-2000	Occupational asthma: annual new cases for different chemical substances	EN	HSE, 2001a
UK	1998-2000 average	Contact dermatitis by causative agent	EN	HSE, 2001b
C. Occupational Accidents and Diseases in the Chemicals Industry				
Europe	2001	Lost Time Injury Rate and Occupational Illness Frequency Rate in the European Chemicals Industry	EN	CEFIC, 2001
Austria	2000	Number of occupational accidents and deaths in the Austrian Chemical Industry	GE	FCIO, 2002
Belgium	1999	Occupational Accidents Frequency Rate	FR	Fedichem, 2001
France	1995-2000	Number of fatalities, accidents per million hours worked, and occupational illnesses	EN	UIC, website
Finland	1988-2001	Lost Time Injuries Frequency Rate and Work Hours Lost	EN	CIFF, 2002
Germany	2002	Number of skin diseases, allergic lung diseases and occupational accidents in the German chemical industry	EN	VCI, 2002
Germany	2001	Accidents, poisonings, diseases (and costs) in the German chemical industry	GE	BG Chemie, 2002
Greece	2000	Number of accidents; working day losses	EN	HACI, website
Italy	2001	Number of accidents per million hours worked and deaths per thousand workers	IT	Federchimica, 2002
Netherlands	1994-2001	Lost Time Injury Rate	DU	VNCI, 2001
Spain	1993-2001	Frequency of accidents and fatal accidents	SP	FEIQUE, 2001
Sweden	2001	Accident rates per 1,000 employees; occupational diseases per 1,000 employees	EN	KemIkontoret, 2002
UK	1996-2001	Number of injuries within the chemical industry (fatal, major, over-3-day) (employees and self-employed)	EN	HSE, 2001a
UK	1996-2001	Employee injury rates	EN	HSE, 2001a
UK	1996-2001	Number of fatal, non-fatal major, and over-3-days injuries due to exposure to harmful substances and drowning/asphyxiation	EN	HSE, 2001a
UK	2000/01	Percentage of occupational injuries (major and over-3-day) in the chemicals industry due to exposure	EN	HSE, 2001a
UK	2001	Industry Sector Profile (Injuries to Employees)	EN	HSE, 2002
UK	1999	Number of deaths from occupational lung disease (2000; over ¾ from mesothelioma/asbestos-no info on chemicals)	EN	BTS, 2001
UK	2001	Number of fatalities, chemicals- and non-chemicals-related injuries,; Lost Time Accident Frequency Rate	EN	CIA, 2001
Public Exposure to Chemicals				
A. Poison Control Centre Data				
EU	1994	Analysis of the Annual Reports of Poison Centres for the year 1994 (problematic classification)	EN	CEC, 1996
France, Lille	2001	Number of poisonings (household products, cosmetic products)	FR	CAPL, 2001

Germany	2000/01	Annual reports from regional poison control centres	GE	
Netherlands	2000	Annual Report of the Dutch Poison Information Centre	NL	RIVM, 2000
Portugal	1996-1999	Accidents (poisonings) with chemicals	EN	Lisbon Poison Centre, 2002
Sweden	2001	Poisonings from chemicals	EN	Stockholm Poison Centre Annual Report, 2002
B. Injuries, Diseases, Deaths of the General Population				
EU	1999	Standardised death rates for cancer, asthma, skin conditions, accidental poisonings	EN	Eurostat, 2002a
EU	1999	Chemical burns, acute poisonings and other poisonings by number of days lost	EN	Eurostat, 2002a
EU	2001	Standard Death Rates for general population for cancer, cerebrovascular, heart, respiratory diseases, external injury & poisonings	EN	WHO, 2002
EU	1997	EUCAN Cancer Incidence Database	EN	EUCAN, 2002
EU		Number of asthmatics in Europe and number of annual deaths from asthma	EN	CEC, undated (a)
UK	1999	Breakdown of deaths from lung diseases (TB, cancer, asthma, pneumonia, flu, etc.)	EN	BTS, 2001
UK	1999/00	National Asthma Campaign: Asthmatics in the UK, new episodes and consultations per year, hospital admissions, deaths	EN	National Asthma Campaign, 2001
Cost of Disease				
EU	1999	Costs to society of work-related injuries and ill-health = 2.6%-3.8% of GNP or Euro185-270 billion for the EU as a whole	EN	CEC, undated (b)
EU	2002 (report)	Lung diseases in the EU: total hospital costs, asthma costs, lung cancer costs. number of hospital days, number of working days lost, cost of ambulance care, inpatient care, drug supply, mortality, rehabilitation, lost work days	EN	ERS, 2002
Austria	1995-2000	Insurance costs of occupational accidents and diseases	EN	AUVA, 2002
Finland	2001	Costs of chemicals-related occupational diseases in Finland	EN	
Germany	2001	Costs of accidents and diseases in the chemicals industry	GE	BG Chemie, 2002
UK	2002	Cost of absence to UK businesses (self-reporting survey)	EN	CIPD, 2002
UK	1999/2000	Days of treatment of asthma, cost to NHS, social security, etc.	EN	National Asthma Campaign, 2001
UK	1999	Estimates of: cost of respiratory disease to health system (primary care, inpatients, outpatients, drugs, production losses from mortality and morbidity, days of certified incapacity---also number of deaths from respiratory diseases	EN	BTS, 2001
UK	2000	Value of fatal risk reduction (VFR) for a future fatality in 2000=£1.1 million (risk at workplace from hazardous substances)	EN	HSE, 1999b
UK	2000	Cost of Occupational asthma=£462-1,078 million (1999/00 prices) **OR** £37,000 for each new case (majority of which lost income to individual, therefore loss for society as a whole) NEW CASES each year: 1,500-3,000	EN	HSE, 1999b

UK	2000	Cost of Occupational Dermatitis case=£4,000-8000; 2,000 cases annually, possibly only half reported, cost excludes lost income which is considerable	EN	HSE, 1999b
Other				
EU	2001	Labour Force Survey (number or employed citizens)	EN	Eurostat, 2002b
EU	1990-2000	EU total population	EN	Eurostat, 2002c

ANNEX 2

AVAILABLE NATIONAL AND EU DATA ON OCCUPATIONAL DISEASES DUE TO CHEMICALS EXPOSURE

Table A2.1: Calculations of Baseline for Occupational Skin Diseases from Exposure to Chemical Agents

Country	Year	Total occupational skin diseases	Chemicals-related occupational skin diseases	Occupational skin diseases linked to exposure to non-specific chemical agents	Occupational skin diseases from exposure to unknown chemicals	Percentage of chemicals-related skin diseases amongst all occupational skin diseases	Non-specific chemicals-related skin diseases as a percentage of total chemical-related skin diseases	Unknown chemicals-related skin diseases as a percentage of total chemical-related skin diseases	Source
Austria	2001		**459**						BMWA, 2002
Belgium	2001	**230** (includes cancers and latex diseases-under-estimate since it does not include diseases related to specific chemicals)	**229** (excludes one case from soot)	**229**	**229** (uncertain - not used in calculations)	(100%)	(100%)	(100%)	FMP FBZ, 2002
Denmark	2001		**1,395**						Danish OEA, 2003
Finland	1999	**1,066**	**499** (does not include diseases from latex, flour, grains, plants, animals, moulds, mechanical fraction, wet work, spray fumes, preservatives)	**422** (does not include isocyanates, known inorganic acids and bases, ammonium compounds, metals and their compounds, cyano compounds, substances known and classified for their effects)	**53** (includes unknown inorganic acids/bases and unspecified substances)	**47%**	**85%**	**11%**	Finnish IOH, 2001
Germany	2001	**1,680**	**1,344** (data from HVBG indicate only 298 skin diseases from chemical substances)			**80%** (estimate)			Zober, 2002
The Netherlands	1999	**227**							NCvB, 1999
Portugal	1997	**1,844**							EU OSHA website
Spain	2001		**2,084** (skin disease attributed to chemicals no						MTAS, 2002

Table A2.1: Calculations of Baseline for Occupational Skin Diseases from Exposure to Chemical Agents

Country	Year	Total occupational skin diseases	Chemicals-related occupational skin diseases	Occupational skin diseases linked to exposure to non-specific chemical agents	Occupational skin diseases from exposure to unknown chemicals	Percentage of chemicals-related skin diseases amongst all occupational skin diseases	Non-specific chemicals-related skin diseases as a percentage of total chemical-related skin diseases	Unknown chemicals-related skin diseases as a percentage of total chemical-related skin diseases	Source
			specifically mentioned-underestimate since it does not include any skin diseases from mentioned chemicals under other headings, for instance isocyanates)						
Sweden	1998	**569** (data for 2001 indicate **687** cases but not further data are provided)	**439** (does not include mould spores, water, welding fumes)	**330** (does not include isocyanates and metals and their compounds)		**77%**	**75%**		SWEA, 2001
United Kingdom	2001	**4,374** (**3,375** contact dermatitis cases)	**2,475** contact dermatitis cases (assuming a proportional relationship between all skin diseases and contact dermatitis cases, this figure relates to **3,208** cases of skin diseases due to occupational chemical exposure)	**1,472** contact dermatitis cases (out of **1,908** estimated skin diseases - the figure for contact dermatitis excludes cases from exposure to wet work, nickel, PPE, flour, cobalt, chromium, temperature and humidity, cement, other metals and medication)	**204** contact dermatitis cases (out of **264** estimated skin diseases)	**57%** (estimate)	**59%** (estimate)	**8.2%** (estimate)	UK HSE, 2002 (website)
EU	1995	**3,713** occupational skin diseases from irritants in workers below 56 y.o.							Eurostat, 2002
EU	1995		**8,797** skin diseases from exposure to						Eurostat, 2002

Table A2.1: Calculations of Baseline for Occupational Skin Diseases from Exposure to Chemical Agents

Country	Year	Total occupational skin diseases	Chemicals-related occupational skin diseases	Occupational skin diseases linked to exposure to non-specific chemical agents	Occupational skin diseases from exposure to unknown chemicals	Percentage of chemicals-related skin diseases amongst all occupational skin diseases	Non-specific chemicals-related skin diseases as a percentage of total chemical-related skin diseases	Unknown chemicals-related skin diseases as a percentage of total chemical-related skin diseases	Source
			proven irritants and allergens						
Sums of national totals		**9,990** (for 7 countries)	**9.657** (for 8 countries)	**2,889** (for 4 countries)	**257** (for 2 countries)	**47-80%** (range)	**59-85%** (range)	**8.2-11%** (range)	(Belgian figures not included in the calculations due to the inclusion of cancers in the available data)
Extrapolation based on employment figures in the EU		**18,283** (estimate)	**15,999** (estimate)	**12,087** (estimate)	**1,364** (estimate)	**88%** (estimate)	**76%** (estimate)	**8.5%** (estimate)	Based on Labour Force Survey 2001 by Eurostat

Table A2.2: Calculations of Baseline for Occupational Respiratory Diseases from Exposure to Chemical Agents

Country	Year	Total occupational respiratory diseases	Chemicals-related occupational respiratory diseases	Occupational respiratory diseases linked to exposure to non-specific chemical agents	Occupational respiratory diseases from exposure to unknown chemicals	Percentage of chemicals related respiratory diseases amongst all occupational respiratory diseases	Non-specific chemical - related respiratory diseases as a percentage of total chemical-related respiratory diseases	Unknown chemical-related respiratory diseases as a percentage of total chemical-related respiratory diseases	Source
Austria	2001	**186** (includes agents such as asbestos, silica, etc.)	**126** (includes substances such as isocyanates and metal dusts)	**69** asthma cases (does not include diseases from known irritants, isocyanates and metal dusts)		**68%**	**55%**		BMWA, 2002
Belgium	2001	**55** (includes silicosis, asbestos and other agents - an under-estimate)	**-** (diseases from chemicals are incorporated in disease statistics for the different chemicals with no distinction of the types of disease they cause)						FMP FBZ, 2002
Denmark	2001		**388** (**160** from non-allergens and **228** from allergens)						Danish OEA, 2003
Finland	1999	**627**	**61** (does not include latex, cosmetics, textiles, mould, flour, enzymes, wood, plants, animals, sprays, mites and toxins)	**43** (does not include chromium, cobalt and nickel and their compounds, isocyanates, substances classified according to their effects and inorganic bases)	**8** (relates to unspecified chemical agents)	**10%**	**70%**	**13%**	Finnish IOH, 2001
France	2000	**3,357** diseases (of which 2,564 due to asbestos)	**292** (includes **255** allergic lung diseases of unspecified cause)		**-**	**9%**			CNAMTS, 2002
Germany	2001	**5,831** (includes registered cases of silicosis,	**1,264** (including aluminium compounds, sintered metals, allergens			**22%**			Deutscher Bundestag, 2002

Table A2.2: Calculations of Baseline for Occupational Respiratory Diseases from Exposure to Chemical Agents

Country	Year	Total occupational respiratory diseases	Chemicals-related occupational respiratory diseases	Occupational respiratory diseases linked to exposure to non-specific chemical agents	Occupational respiratory diseases from exposure to unknown chemicals	Percentage of chemicals related respiratory diseases amongst all occupational respiratory diseases	Non-specific chemical - related respiratory diseases as a percentage of total chemical-related respiratory diseases	Unknown chemical-related respiratory diseases as a percentage of total chemical-related respiratory diseases	Source
		asbestosis, allergic alveolitis, etc.)	and irritant chemical agents)						
Italy	1999	**146** (including asbestosis, silicosis, siderosis, etc.)							ISPESL, 1999
The Netherlands	1999	**93** (including 40 asthma cases and 13 allergic alveolitis)							NCvB, 1999
Spain	2001	**521** (includes silicosis, asbestosis, pneumonoconiosis, etc.)	**434** (**294** asthma, **130** lung irritation cases, **9** cases associated with metals and **1** other)	**295** ("asthma" and "other" not linked to specific chemicals)		**83%**	**68%**		MTAS, 2002
Sweden	1998	**389**	**167** (including metals and isocyanates, but excluding mould, water, asbestos, welding fumes)	**138** (does not include metals or isocyanates)		**43%**	**83%**		SWEA, 2001
United Kingdom	2001	**4,203**	**2,128** (asthma plus chronic bronchitis or emphysema)	**688** (chronic bronchitis plus asthma cases calculated below)	**47**	**51%**	**32%**	**2.2%**	UK HSE, 2002 (website) - see calculations below
EU - 1	1995	**9,653** pulmonary diseases for workers below 56 y.o.							Eurostat, 2002
EU - 2	1995		**4,543** allergies from known allergens (including sintered						Eurostat, 2002

Table A2.2: Calculations of Baseline for Occupational Respiratory Diseases from Exposure to Chemical Agents

Country	Year	Total occupational respiratory diseases	Chemicals-related occupational respiratory diseases	Occupational respiratory diseases linked to exposure to non-specific chemical agents	Occupational respiratory diseases from exposure to unknown chemicals	Percentage of chemicals related respiratory diseases amongst all occupational respiratory diseases	Non-specific chemical - related respiratory diseases as a percentage of total chemical-related respiratory diseases	Unknown chemical-related respiratory diseases as a percentage of total chemical-related respiratory diseases	Source
			metals, Co, Sn, Ba and their compounds)						
Sums of national totals		**15,408** (for 10 countries)	**4,860** (for 8 countries)	**1,233** (for 5 countries)	**55** (for 2 countries)	**9-83%**	**32-83%**	**2.2-13%**	(Belgium data not included in the calculations due to the inclusion of lung cancers in the available data)
Extrapolation based on employment figures in the EU		**16,820 (estimate)**	**6,700 (estimate)**	**3,678 (estimate)**	**274 (estimate)**	**40%**	**55%**	**4.1%**	Based on Labour Force Survey 2001 by Eurostat

UK: Occupational asthma incidence: 6 per 100,000 workers or (on the basis of Eurostat data on Labour Force) **1,679** workers. Total occupational respiratory diseases: total disablement cases plus asthma without disablement = 2,670+(1,679-146) = **4,203** (146 are the disablement cases for asthma). From the UK HSE Statistics (Table ODINR07): **291** out of a total of **855** asthma-related consultations with physicians (34% of total) referred to exposure to chemicals (96 referred to unspecified chemicals (11.2% of total) of which 24 where unknown (2.8% of total)). These are average figures for the period 1999-2001. Therefore out of 1,679 workers developing asthma 34% or **571** develop asthma due to exposure to chemicals (**188** due to exposure to unspecified chemicals of which **47** due to exposure to unknown chemicals).

Table A2.3: Numbers of Chemicals-related Occupational Eye Disorders in EU Member States				
Country	**Year**	**Number of eye disorders**	**Causative agent**	**Source**
Denmark	2001	The **40** diseases under the title "nervous system, sense organ diseases" which we include in our CNS calculations could include eye disorders	Chemical substances	Danish OEA, 2003
Finland	2001	**9** (conjunctivitis)	Chemical substances	STM, 2003
France	2000	**3** (viral keratoconjunctivitis)	All	CNAMTS, 2002
Germany	2000	**3** (suspected eye diseases from benzoquinone-none registered) **2** (suspected eye disorders in miners-none registered)	All	Deutscher Bundestag, 2002
Ireland	1999	**168** (conjunctivitis incapacitation)	All	EU OSHA website
Sweden	2000	**20** (eye and immediate organs)	Chemical and biological agents	SWEA, 2001
EU	1995	**50** (eye disorders)	All	Eurostat, 2002

Table A2.4: Calculations of Baseline for Occupational Central Nervous System (CNS) Diseases from Exposure to Chemical Agents

Country	Year	Total occupational CNS diseases	Chemicals-related occupational CNS diseases	Occupational CNS diseases linked to exposure to non-specific chemical agents	Occupational CNS diseases from exposure to unknown chemicals	Percentage of chemicals related CNS diseases amongst all occupational CNS diseases	Non-specific chemical - related CNS diseases as a percentage of total chemical-related CNS diseases	Unknown chemical-related CNS diseases as a percentage of total chemical-related CNS diseases	Source
Austria	2001		**3** Polyneuropeathies (from organic solvents)	**3**			**100%**		BMWA, 2003
Denmark	2001		**110** (40 registered nervous system diseases and 70 registered brain damages)						Danish OEA, 2003
Finland	2001	**53** (toxic encephalopathyies and mononeuropathies)	**13** (only toxic encephalopathies included)			**26%**			STM, 2003
Germany	2001	**18** registered encephalopathies from exposure to organic solvents	**18**			**100%**			Deutsche Bundestag, 2002
The Netherlands	1999	**33** (registered cases of chronic toxic encephalopathy)	**33**			**100%**			NCvB, 1999
Sweden	1998		**27** nervous system diseases due to exposure to chemical and biological agents	**23** (does not include metals or isocyanates)			**85%**		SWEA, 2001
Sums and averages of national totals		**104** (for 3 countries)	**204** (for 6 countries)	**26** (for 2 countries)	**Insufficient data available**	**26-100%**	**85-100%**	**Insufficient data available**	

Table A2.4: Calculations of Baseline for Occupational Central Nervous System (CNS) Diseases from Exposure to Chemical Agents

Country	Year	Total occupational CNS diseases	Chemicals-related occupational CNS diseases	Occupational CNS diseases linked to exposure to non-specific chemical agents	Occupational CNS diseases from exposure to unknown chemicals	Percentage of chemicals related CNS diseases amongst all occupational CNS diseases	Non-specific chemical - related CNS diseases as a percentage of total chemical-related CNS diseases	Unknown chemical-related CNS diseases as a percentage of total chemical-related CNS diseases	Source
Extrapolation based on employment figures in the EU		**357** (estimate)	**572** (estimate - note, this is higher than the number of total occupational diseases due to the high figure for Denmark)	**485** (assuming 85% of total chemicals-related CNS diseases)	-	**85%** (assumption based on Swedish data)		**Insufficient data available**	Based on Labour Force Survey 2001 by Eurostat